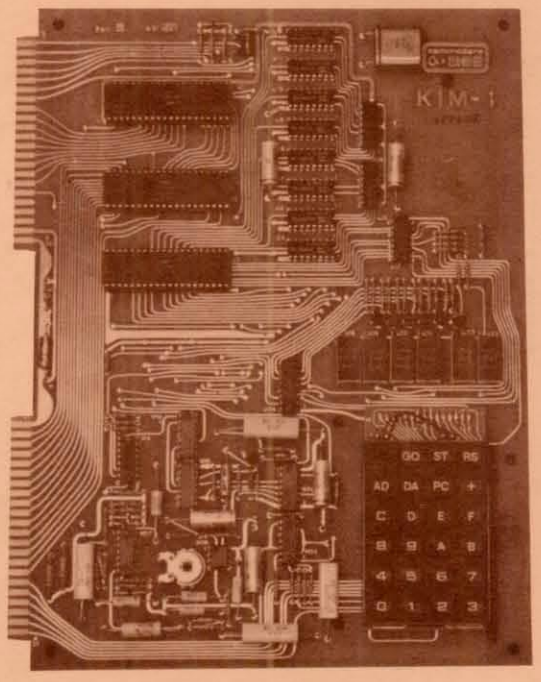
# MICRO™

The Magazine of the APPLE, KIM, PET

and Other 6502 Systems

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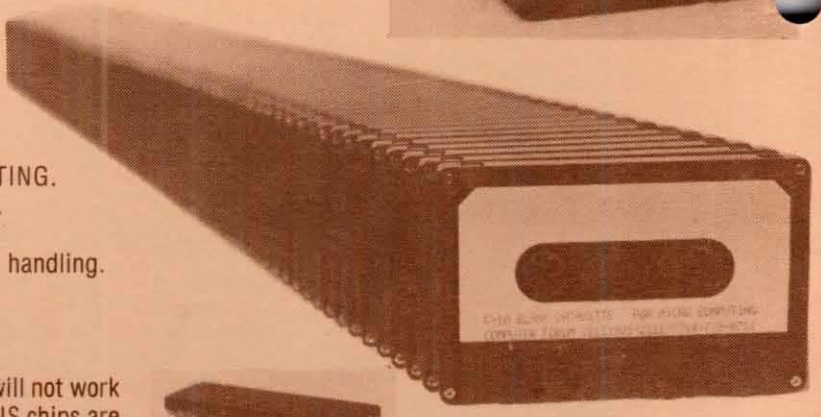

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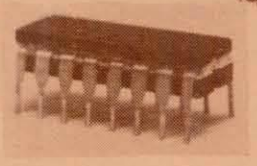

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APRIL 1979
ISSUE NUMBER ELEVEN

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## IN THIS ISSUE ...

Andrew V. W. Sensicle increases the power of the basic KIM-1 with "EKIM OR MAXI-KIM", a small, page 17 monitor extension. This supports a PC "decrement" to compliment the normal "increment" function, "open up" and "close up" modes to move blocks of data to make room for adding code, and a "branch" calculator which simplifies determining the relative branch addresses.

Robert A. Stein, Jr. provides "A CASSETTE OPERATING SYSTEM FOR THE APPLE II" which makes it possible to maintain a library of programs which can be loaded by name from cassette. The article includes a cassette control circuit as well as the programs in assembler and BASIC to run the system.

Alan G. Hill presents "AN APPLE II PROGRAM EDIT AID" which helps the user locate all occurences of any variable name, character string, or BASIC statement. The article includes a short assembler level program and a BASIC demo program.

J. Stelly makes it a lot easier to use the game of LIFE on your PET with his "LIFESAVER". This program supports creating a LIFE pattern, running LIFE at various rates, and saving and loading LIFE patterns on cassette.

Nicholas J. Vrtis helps overcome the SYM-1's KIM tape "2F" problem with a "CORRECTED KIM tape "2F" problem with a "CORRECTED KIM FORMAT LOADER FOR SYM-1". This program is carefully written with an interesting "trick" so that it does not itself contain a "2F" even though it must test for this troublesome character.

Bruce Hoyt comes through with a lot of good info on the OSI with "A CLOSE LOOK AT THE SUPERBOARD II". In addition to an overview, he presents a cassette save/hex memory dump program and a very useful table of memory usage.

Robert M. Tripp continues "ASK THE DOCTOR", a series on the AIM/SYM/KIM family of microcomputers, with a "Corrected AIM Sync Program", a "Patch for the AIM Disassembler", a "SYM Tape Evaluation", and "Comments on Synertek BASIC". Most of the info in this month's section has been provided by other ASK users.

"THE MICRO SOFTWARE CATALOG" continues with ten new entries.

John Gieryic has a tutorial article on a "SYM 6522-BASED TIMER" that gives insight into the workings of the 6522 VIA as well as the SYM.

Edward Chalfin has "THE TVT-6: A USER'S REPORT" which give his experiences and impressions of Don Lancaster's inexpensive method of getting a video signal out of a KIM-1.

William R. Dial continues to cover the expanding 6502 literature in his "6502 BIBLIOGRAPHY".

Don Rindsberg presents a major program in "THE ULTIMATE PET RENUMBER". This complete program can be used to rapidly renumber BASIC programs. The article also includes other useful info.

## MICRO INTERRUPTS

The BEST of the PET GAZETTE has recently been published and should be of interest to all PET owners. It is available for $9.95 from:

Microcomputer Resource Center, Inc.
1929 Northport Drive, Room 6
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### 6502 COMPUTER GROUPS

The New England Apple Tree is now meeting on the third Wednesday of each month, 7 - 10:00 PM, at the cafeteria of the MITRE Corp. in Bedford, MA. You can contact, for further information:

Richard F. Suitor
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The Carolina Apple Core has been formed in the Research Triangle Area of North Carolina. The monthly meetings are on the third Tuesday of the month at different locations. Annual dues are $5.00 and include a monthly newsletter. Contact

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New York City now has an Apple users group: The Big Apple Users Group. Meetings are the second Tuesday of every month at the Computer Mart of Manhattan at 6:30 PM. For further info contact:

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516/579-4295 (home)
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The Apple Corps of San Diego is publishing an eight page newsletter. Unfortunately, by the time it reaches us, the information on the next meeting is too dated for us to print. The person to contact for information is:

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***** ATTENTION ALL 6502 CLUBS *****

Now that MICRO is published monthly, we can get the word out on when and where you are meeting - if you get the word in to us. We need times and dates and places by the first of the preceeding month - April 1 for the May issue and so forth. Also, please put us on your mailing list for any newsletter or other material you send out. We want to help your club prosper by giving it as much exposure as possible, but we need your input to make it happen.

*** On The Cover ***

With all of the new 6502 based microcomputers, it is easy to forget about the KIM-1 which was the first 6502 system. Many thousands have been sold, and after a period of production problems, the quality of the KIM-1 has been remarkably improved recently. Considering all of the articles we continue to receive about the KIM-1, it looks as though this system is here to stay for a long time.

apple II

# PET™

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## AN APPLE II PROGRAM EDIT AID

Alan G. Hill
12092 Deerhorn Dr.
Cincinnati, OH 45240

When editing an Apple Integer Basic program, you often want to locate all occurrences of a variable name, character string, or BASIC statements. This is usually the case when you are changing a variable name, moving a subroutine, etc., and you want to be sure you have located all references. The BASIC Edit program presented here should aid your editing.

The BASIC program should be loaded into high memory and the program to be edited appended to it. The Edit program uses a machine language routine at hex 300 to 39F to search BASIC statements for the requested string and return the BASIC line number in memory locations 17 and 18. The routine is re-entered at 846 to find the line number of the next occurrence. This process is continued until no further occurrences can be found. The high order byte of the line number (location 18) is set to hex FF to indicate that the search is finished.

### BASIC Edit Program

Note in line 32680 of the BASIC program that LIST LINE is an invalid BASIC statement. You will have to resort to a little chicanery to get the statement in. First code line 32680 as PRINT LINE. Then, enter the monitor and change the PRINT token ($62) to a LIST token ($74). This is easiest done if you code line 32680 first and then search for the token in high memory ($3FFA when HIMEN is 16384).

After coding the BASIC program and the machine language routine, you will then need to append the program to be edited. Note that the program must have line numbers less than 32600. To append a program, you must first "hide" the Edit program. This is done by moving the HIMEN pointer (202) and (203) down below the Edit program. Then load the edited program and reset HIMEM: i.e.:

```
LOAD (EDIT PROGRAM)
POKE 76, PEEK (202)
POKE 77, PEEK (203)
LOAD (PROGRAM TO BE EDITED)
POKE 76,0 HIMEM MOD 256
POKE 77,64 HIMEM/256
```

You can then RUN 32600 the Edit program. Enter the character string or variable name to be searched when prompted by "FIND?". To search for a hex string (e.g. all occurrences of COLOR=), enter an @ character followed by the desired hex character pair (@66 for the COLOR= example)

EXAMPLES

| **To find all occurrences of:** | **Input** |
|---|---|
| SCORE | SCORE |
| XYZ | XYZ |
| RETURN | @5B |
| DIM A | @4EC1 |
| All references to 1000 | @E803 |

The Edit program will end if the screen is full ( > 18 lines). To continue the search for more occurrences, a RUN 32720 will return another page. Happy Editing!

### Find Routine
### Page Zero Memory Map

| | |
|---|---|
| $3-4 | Address of search limit. Set to HIMEM by routine, but could be set lower to avoid searching Edit program. |
| $6-7 | Address of BASIC Token compared. Incremented until it exceeds Limit Address |
| $8-9 | Ending address - 1 of current statement being scanned |
| $A-B | Address of string being searched. Set up by Edit program |
| $ C | Length - 1 of string being searched. Set up by Edit program |
| $11-12 | Line number of statement containing the requested string. $12 is set to $FF if no more occurrences |

```
FIND ROUTINE

A. G. HILL
MARCH 1979

HILO    *       $0003   HIMEM LO BYTE
HIHI    *       $0004   HIMEM HI BYTE
BSL     *       $0006   BASIC STATEMENT LO
BSH     *       $0007   BASIC STATEMENT HI
SEAL    *       $0008   STATEMENT ENDING ADDRESS LO
SEAH    *       $0009   STATEMENT ENDING ADDRESS HI
STRL    *       $000A   STRING LO
LNL     *       $0011   LINE NUMBER LO
LNH     *       $0012   LINE NUMBER HI
```

```
0300                    ORG   $0300

0300 A5 CA     START    LDA   $00CA   SET UP ADDRESS OF FIRST
0302 85 06              STA   BSL     BASIC STATEMENT IN
0304 A5 CB              LDA   $00CB   LOCS 6 AND 7
0306 85 07              STA   BSH
0308 A5 4C              LDA   $004C   SET UP TO STOP SEARCH
030A 85 03              STA   HILO    AT HIMEM.  COULD BE
030C A5 4D              LDA   $004D   CHANGED TO LIMIT SEARCH
030E 85 04              STA   HIHI    AT END OF PROGRAM BEING EDITED
0310 A0 00     LENGTH   LDYIM $00     GET STATEMENT LENGTH
0312 B1 06              LDAIY BSL
0314 38                 SEC
0315 E9 02              SBCIM $02     MINUS 2 TO POINT TO
0317 18                 CLC           LAST TOKEN IN STATEMENT
0318 65 06              ADC   BSL
031A 85 08              STA   SEAL    SET UP STATEMENT ENDING
031C A5 07              LDA   BSH     ADDRESS IN 8 AND 9
031E 69 00              ADCIM $00     ADD IN CARRY IF ANY
0320 85 09              STA   SEAH
0322 A0 01              LDYIM $01     SAVE LINE NUMBER IN
0324 B1 06              LDAIY BSL     IN 11 AND 12
0326 85 11              STA   LNL
0328 C8                 INY
0329 B1 06              LDAIY BSL
032B 85 12              STA   LNH
032D A2 00              LDXIM $00     ADJUST BSL TO POINT
032F A9 03              LDAIM $03     TO FIRST TOKEN
0331 20 64 03           JSR   INCPNT
0334 A0 00              LDYIM $00     COMPARE TOKEN TO
0336 B1 06     TTOKEN   LDAIY BSL     FIRST CHARACTER IN
0338 D1 0A              CMPIY STRL    STRING
033A D0 03              BNE   NXTOKN  IF NOT EQUAL POINT TO NEXT
033C 20 7F 03           JSR   COMPAR  IF EQUAL COMPARE REMAINING CHARS
033F 20 70 03  NXTOKN   JSR   INCTOK  POINT TO NEXT TOKEN
0342 90 F2              BCC   TTOKEN  CARRY CLEAR THEN LOOK AT NEXT
0344 A5 08              LDA   SEAL    AT END OF STATEMENT.
0346 C5 03              CMP   HILO    CHECK TO SEE IF AT END OF
0348 A5 09              LDA   SEAH    SEARCH LIMIT
034A E5 04              SBC   HIHI
034C B0 11              BCS   LIMIT   CARRY SET = LIMIT OF SEARCH
034E A5 08              LDA   SEAL    SET UP BSL AND BSH TO POINT
0350 85 06              STA   BSL     TO NEXT STATEMENT
0352 A5 09              LDA   SEAH
0354 85 07              STA   BSH
0356 A2 00              LDXIM $00     POINT TO LENGTH OF
0358 A9 02              LDAIM $02     STATEMENT BYTE
035A 20 64 03           JSR   INCPNT
035D D0 B1              BNE   LENGTH  ALWAYS BRANCH

035F A9 FF     LIMIT    LDAIM $FF     SET UP LARGE LINE NUMBER
0361 85 12              STA   LNH     TO INDICATE AT END OF SEARCH
0363 60                 RTS           RETURN TO BASIC
```

```
0364 18        INCPNT CLC            ROUTINE TO INCREMENT
0365 75 06            ADCX  BSL      POINTERS.  ENTER WITH
0367 95 06            STAX  BSL      XREG = DISPLACEMENT
0369 B5 07            LDAX  BSH      FROM
036B 69 00            ADCIM $00      BSL, BSH
036D 95 07            STAX  BSH      ACC = INCREMENT AMOUNT
036F 60               RTS

0370 A5 06     INCTOK LDA   BSL      ROUTINE TO INCREMENT
0372 C5 08            CMP   SEAL     THE TOKEN ADDRESS BY 1
0374 A5 07            LDA   BSH      SET CARRY IF AT END
0376 E5 09            SBC   SEAH     OF STATEMENT
0378 E6 06            INC   BSL
037A D0 02            BNE   REXIT
037C E6 07            INC   BSH
037E 60        REXIT  RTS

037F A4 0C     COMPAR LDY   $000C     ROUTINE TO COMPARE
0381 B1 0A     COMPY  LDAIY STRL     REMAINING CHARACTERS
0383 D1 06            CMPIY BSL      (C) LENGTH OF CHARACTER
0385 F0 03            BEQ   COMPX    STRING -1
0387 A0 00            LDYIM $00      RESET YREG
0389 60               RTS
038A 88        COMPX  DEY
038B 10 F4            BPL   COMPY    FOUND A MATCH! POP STACK ADDRESS
038D 68               PLA            AND RETURN TO BASIC.  LINE NUMBER
038E 68               PLA            IS ALREADY IN LNL AND LNH.
038F 60               RTS
```

BASIC EDIT PROGRAM

```
32600 DIM A$(30)
32610 INPUT "FIND?",A$: CALL -936:
      IF A$(1,1)="@" THEN 32630:
      KK=LEN(A$): FOR I=1 TO KK:
      POKE 911+I,ASC(A$(I,I)): NEXT I
32620 POKE 12,KK-1: GOTO 32650
32630 A$=A$(2,LEN(A$)): KK=LEN(A$):
      FOR I=1 TO KK STEP 2:
      I=ASC(A$(I,I))-176:
      JJ=ASC(A$(I+1,I+1))-176
32640 IF J>9 THEN J=J-7:
      IF JJ>9 THEN JJ=JJ-7:
      POKE 912+I/2,J*16+JJ: NEXT I:
      POKE 12,KK/2-1
32650 POKE 10,912MOD256: POKE 11,912/256
32660 CALL 768
32670 IF PEEK(18)>127 THEN 32730:
      LINE=PEEK(17)+PEEK(18)*256
32680 LIST LINE
32690 IF PEEK(37)>18 THEN 32730
32700 CALL 846
32710 GOTO 32670
32720 CALL -936: GOTO 32700
32730 END
```


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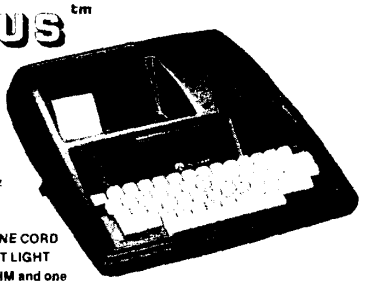

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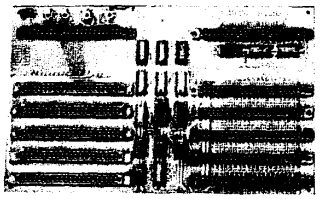

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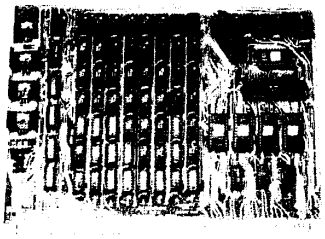

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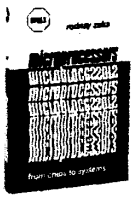

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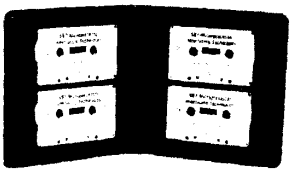

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# LIFESAVER

by J. Stelly
10918 Dunvegan Wav
Houston, TX 77013

Is LIFE passing you by; does it progress so quickly than there is little time to enjoy it? Well, fear not--the LIFESAVER is here. Though time marches on, now you are in control. If you got "LIFE For Your PET" from Dr. Frank H. Covitz (**The Best of Micro**, p.65), LIFE moves along at a pretty good clip. LIFESAVER is a BASIC program that complements and provides some enhancements to Dr. Covitz machine language routines.

LIFESAVER provides a convenient grid for setting up cellular patterns, permits saving and loading of patterns on the built in cassette unit, and gives complete control of the time interval between generations. You may even single step through the LIFE sequences.

Commodore is supposedly mailing all owners of early model PET units the TIM monitor on cassette, so I will assume its availability in this discussion. It ain't the best monitor in the world, but it does allow you to load machine language programs directly from the cassette without any special loader routines. This does not exclude other methods the reader may have at his (or her) disposal if TIM is not available.

A single modification to Dr. Covitz program is required before it can be used with LIFESAVER. Location 191D (16) should be changed to read:

191D 60 RTS

When this change is made the program may be entered at 190A(16) e.g. SYS(6410). If the TIM monitor is used, simply do a hex dump of the machine language listing and save the program on tape using the instructions given in the manual.

Before loading LIFE (Dr. Covitz program) or LIFESAVER (by yours truly) from cassette, I recommend the following command be executed:

POKE 134,0:POKE 135,24

This lowers the BASIC boundary and prevents conflicts between the two programs. The regular BASIC limit can later be reinstated by POKE 135,32. It is also a good idea to load LIFE before LIFESAVER is loaded. This prevents the data pointer from getting initialized to the wrong location.

It may be possible to eliminate lines 3015 and 3035 from the BASIC listing, if you have a relatively late model PET. These lines are necessary for the older units that have a problem with writing file headers and cassette motor start/stop control. My unit was delivered in Sept. '78 and I was able to eliminate these lines.

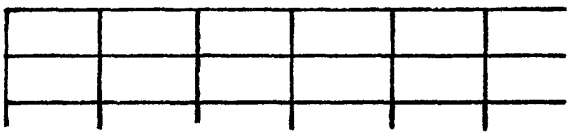
Assuming that both LIFE and LIFESAVER have successfully been loaded, you may begin entering your favorite cell patterns. Please refer to Dialog 1 (human inputs are underlined) to see how this is done. After the grid is printed simply press the 'RETURN' key and enter your pattern anywhere in the grid area using the cursor keys and the dot (•) symbol above the Q key. After you've created the desired pattern press the 'HOME' key and the 'RETURN' key in succession. This neat little trick returns control to the LIFESAVER routine without having to explicitly key in the command 'GOTO 1000'. After the PET has saved the pattern internally the user then has the options to save it on tape, have the computer generate LIFE patterns as described in Dr. Covitz article, or scrap it and input a new pattern.

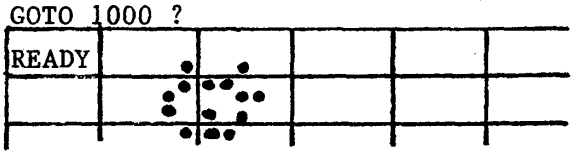
The options are relisted after the execution of any LIFESAVER command. Examples on exercising the different options are given in the remaining dialogs.

LIFESAVER should relieve the user from the tedium of having to manually reenter a LIFE pattern every time it is desired to run it. It should also encourage the user to experiment with various LIFE forms, some of which are quite dazzling.

DIALOG 1

```
RUN

LIFE

PLEASE CHOOSE AN OPTION

1. CREATE A PATTERN
2. RUN LIFE GENERATOR
3. LOAD A PATTERN FROM CASSETTE
4. SAVE A PATTERN ON CASSETTE

OPTION NUMBER ? 1 (RETURN)

     (SCREEN CLEARS, THEN ...)

GOTO 1000 ?
```



```
(At this point the user hits the
RETURN key and proceeds to input a
cell pattern.)

GOTO 1000 ?
READY
```

```
(With the desired pattern on the CRT
the user presses the HOME and RETURN
keys to resume program execution.)

STORING CELL PATTERN

(After a slight delay the computer
again responds with the option list.)
```

DIALOG 2

```
LIFE
  .
  .
(Option List)
  .
  .
OPTION NUMBER ? 2 (RETURN)

(Screen clears ...)

HOW MANY GENERATIONS ? 7
DEVELOPMENT RATE
0:SINGLE STEP VIA (G) KEY
1-99:INTERMEDIATE RATES
100:MAX (255 GENERATION LIMIT)

RATE ? 75

(The computer proceeds to display
generations sequentially at the
specified rate.  The larger the
numerical value of the rate the
faster the generations are produced.
A rate of 0 meanc that only one
generation is produced at a time.
The G key must be pressed to obtain
subsequent generations.)
```

DIALOG 3

```
LIFE
  .
  .
(Option list)
  .
  .
OPTION NUMBER ? 4

(Screen clears ...)

HOW MANY
PATTERN NAME ? CHESIRECAT (RETURN)

(Pattern is saved and the option
list is printed.)

NOTE:  In the following BASIC listing
the lower case abbreviations stand for
cursor control keys and have the
following meaning:

      clr = clear screen
      home = home up
      cd = cursor down
      s = space key
```

LISTING

```
1     REM LIFESAVER
2     REM BY JAMES W. STELLY
3     REM POKE 135,24 BEFORE USING
100   DIM A$(25)
110   PRINT "clrLIFE":PRINT
120   PRINT "PLEASE CHOOSE AN OPTION:":PRINT
130   PRINT "1. CREATE A PATTERN"
140   PRINT "2. RUN LIFE GENERATOR"
150   PRINT "3. LOAD A PATTERN FROM CASSETTE"
160   PRINT "4. SAVE PATTERN ON CASSETTE"
170   INPUT "OPTION NUMBER";N
180   ON N GOSUB 200,2000,4000,3000
190   GOTO 110

      CREATE GRID FOR PATTERN INPUT

200   PRINT "clr cd";
210   FOR I=1 TO 5
220   PRINT "┌───┬───┬───┬───┬───┬───┬───┬───┬───┐
230   PRINT "
240   PRINT "
250   PRINT ":
260   NEXT I
270   PRINT "└───┴───┴───┴───┴───┴───┴───┴───┴───┘
280   PRINT "
290   PRINT "
300   PRINT "└──┴──┴──┴──┴──┴──┴──┴──┴──┘
310   INPUT "home GOTO 1000";A$
```

```
     STORE PATTERN
1000 PRINT "homeSTORING CELL PATTERN"
1010 FOR I=1 TO 24:A$(I)="":NEXT I
1020 FOR I=1 TO 24:FOR J=1 TO 39
1030 IF PEEK(32767+J+(I*40))= 81 THEN A$(I)=A$(I)+"●":GOTO 1050
1040 A$(I)=A$(I)+"-"
1050 NEXT J:NEXT I
1060 RETURN

     ACCESS LIFE GENERATOR
2000 INPUT "clrHOW MANY GENERATIONS";G
2010 PRINT "cdDEVELOPEMENT RATE:":PRINT
2020 PRINT "0;SINGLE STEP VIA (G) KEY"
2030 PRINT "1-99:INTERMEDIATE RATES"
2040 PRINT "100:MAX (255 GENERATIONS LIMIT)"
2050 INPUT "cdRATE";S
2060 PRINT "clrGEN 0"
2070 FOR I=1 TO 23:PRINT A$(I): NEXT I
2075 PRINT A$(I);:FOR I=1 TO 2000:NEXT I
2080 IF S=100 THEN POKE 6483,256-G:SYS(6410):GOTO 2140

     INTERMEDIATE RATES
2100 POKE 6483,255:IF S=0 GOTO 2160
2110 S=100-S:FOR I=1 TO G
2120 SYS(6410):PRINT "homeGEN";I
2130 FOR J=1 TO S*30:NEXT J:NEXT I
2140 GET A$:IF A$<>"X" GOTO 2140
2150 RETURN

     SINGLE STEP
2160 G=1
2170 SYS(6410):PRINT "homeGEN";G
2180 GET A$: IF A$="X" THEN RETURN
2190 IF A$="G" THEN G=G+1: GOTO 2170
220  GOTO 2180

     SAVE PATTERN
3000 INPUT "clrPATTERN NAME";A$
3010 OPEN 1,1,1,A$
3015 POKE 243,122:POKE 244,2
3020 FOR I=1 TO 24
3030 PRINT#1,A$(I)
3035 POKE 59411,53
3040 NEXT I
3050 CLOSE 1:RETURN

     LOAD PATTERN
4000 INPUT "clrPATTERN NAME";A$
4010 OPEN 1,1,0,A$
4020 FOR I=1 TO 24:INPUT#1,A$(I):NEXT I
4030 CLOSE 1:RETURN
```

## CORRECTED KIM FORMAT LOADER FOR SYM-1

Nicholas J. Vrtis
5863 Pinetree S.E.
Kentwood, MI 49508

My cassette is an old model GE, and it won't quite hack the high speed tape format of the SYM-1, so I have probably used the KIM format option more than most SYM owners. In the process, I have found a bug in the SYM monitor tape load routine. Synertek knows about the problem, but didn't have a nice fix when I called, so I worked up the attached program.

The problem with the monitor routines is that they will not load a slash (hex 2F) from a KIM format tape. The slash is used to indicate that the data is done, and the checksum follows. The monitor routines don't check for the slash until after the KIM characters have been read and combined. The error you get is a checksum error (ER CC).

Most of the code for this program has been copied from the SYM monitor routines, except these work. The basic logic change is that when a slash is read as a single KIM byte, it is treated as a non-hex character. The non-hex routine checks for the slash instead of after every character. If it is a slash, it goes to the checksum check routine.

This routine is not as fancy as the monitor routines, but it sure beats re-keying a couple K bytes of program. It has turned out to be convenient to have this program available even for loading programs without the slash. By changing the branch after the compare for the slash to a branch back to LOADT7 it will ignore errors. Sometimes this will load a bad tape with only minor errors. Other times the program gets out of sync and loads garbage. It is worth the try for a tape you have spent a lot of time on.

One final comment about cassettes. If you have the remote control connected, putting a hex CC into location A00C will turn the cassette motor back on. It is easier than yanking the remote plug.

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```
                        FIXED SYM-1 KIM FORMAT LOADER

                        NICHOLAS J. VRTIS
                        MARCH 1979

                        STRIPPED DOWN VERSIONS OF L1 COMMAND.
                        WILL LOAD A 2F WHICH CAUSES SYM-1 TROUBLE.
                        ONLY FOR KIM FORMAT TAPES.
                        ID SHOULD BE PUT INTO LOCATION 0000.

0080                    CHAR    *       $00FC   CHAR ASSEMBLY & DISASSEMBLY
0080                    MODE    *       $00FD
0080                    BUFADL  *       $00FE   CURRENT CHAR INDIRECT ADDRESS
0080                    BUFADH  *       $00FF

                        SYM-1 REFERENCES

0080                    DDRIN   *       $A002
0080                    VIAACR  *       $A00B
0080                    LATCHL  *       $A004

0080                    ACCESS  *       $8BA6
0080                    SLASH   *       $8D3C   SLASH IN SYM MONITOR
0080                    LOADTX  *       $8D4F
0080                    NHERR   *       $8D69
0080                    SYNC    *       $8D82
0080                    START   *       $8DB6
0080                    RDBYTX  *       $8E28
0080                    PACKT   *       $8E3E
0080                    RDCHT   *       $8E61
0080                    CHKT    *       $8E78

0000                            ORG     $0000

0000 00                 ID      =       $00     RESERVED FOR PROGRAM ID

0001 20 A6 8B   LOADT   JSR     ACCESS  UN-PROTECT SYSTEM RAM
0004 A0 00              LDYIM   $00     SET KIM MODE
0006 20 B6 8D           JSR     START   INITIALIZE
0009 AD 02 A0           LDA     DDRIN
000C 29 BF              ANDIM   $BF     BIT 6 = 0 INPUT IS PB6
000E 8D 02 A0           STA     DDRIN
0011 A9 00              LDAIM   $00
0013 8D 0B A0           STA     VIAACR
0016 A9 AE              LDAIM   $AE     SET UP CLOCK FOR GETTR (KIM)
0018 8D 04 A0           STA     LATCHL  STORE GETTR VALUE IN LO LATCH
001B 20 82 8D   LOADTA  JSR     SYNC    GET IN SYNC
001E 20 61 8E   LOADTB  JSR     RDCHT
0021 C9 2A              CMPIM   '*      START OF DATA ?
0023 F0 06              BEQ     LOADTC
0025 C9 16              CMPIM   $16     NO - SYNC CHARACTER?
0027 D0 F2              BNE     LOADTA  IF NOT, RESTART SYNC SEARCH
0029 F0 F3              BEQ     LOADTB  IF YES, KEEP LOOKINT FOR THE *
```

```
002B A9 00      LOADTC LDAIM $00    CLEAR "NOT IN SYNC BIT"
002D 85 FD             STA   MODE

002F 20 28 8E          JSR   RDBYTX READ ID BYTE

                       CHANGE THE FOLLOWING IF ID LOCATION IS
                       NOT HEX 0000

0032 C5 00             CMP   ID      COMPARE WITH REQUESTED ID
0034 F0 02             BEQ   LOADTD  GO LOAD IF EQUAL
0036 D0 E3             BNE   LOADTA  UNCONDITIONAL - RESTART SEARCH

0038 20 28 8E  LOADTD  JSR   RDBYTX GET SAL FROM TAPE
003B 20 78 8E          JSR   CHKT
003E 85 FE             STA   BUFADL PUT IN BUF START LOW
0040 20 28 8E          JSR   RDBYTX SAME FOR SAH
0043 20 78 8E          JSR   CHKT
0046 85 FF             STA   BUFADH

                       THE FOLLOWING JSR RDBYT IS THE ONLY
                       INSTRUCTION THAT WOULD HAVE TO CHANGE
                       TO RE-LOCATE THIS PROGRAM

0048 20 67 00  LOADTE  JSR   RDBYT  GET A BYTE INPUT
004B B0 0F             BCS   XNHERR BRANCH IF NON-HEX
004D 20 78 8E          JSR   CHKT   INCLUDE IN CHECKSUM
0050 A0 00             LDYIM $00    STORE BYTE
0052 91 FE             STAIY BUFADL
0054 E6 FE             INC   BUFADL BUMP BUFFER ADDRESS
0056 D0 F0             BNE   LOADTE BRANCH IF NO CARRY
0058 E6 FF             INC   BUFADH ELSE NEED TO UPDATE HIGH ORDER
005A D0 EC             BNE   LOADTE UNCONDITIONAL

005C CD 3C 8D  XNHERR  CMP   SLASH  "/" IN SYM MONITOR
005F D0 03             BNE   YNHERR WAS IT REALLY AN ERROR
0061 4C 4F 8D          JMP   LOADTX NOW LET HIM HANDLE CHECKSUM
0064 4C 69 8D  YNHERR  JMP   NHERR  LET MONITOR DO THIS ALSO

0067 20 61 8E  RDBYT   JSR   RDCHT  READ ONE HALF
006A CD 3C 8D          CMP   SLASH  SEE IF A SLASH
006D D0 02             BNE   RDBYTA BRANCH IF NOT
006F 38                SEC          SET CARRY AS NON-HEX
0070 60                RTS          AND RETURN

0071 20 3E 8E  RDBYTA  JSR   PACKT  SEE IF GOOD CHARACTER
0074 90 01             BCC   RDBYTB BRANCH AROUND RETURN IF HEX
0076 60                RTS

0077 AA        RDBYTB  TAX          SAVE MSD
0078 20 61 8E          JSR   RDCHT  GET NEXT HALF CHARACTER
007B 86 FC             STX   CHAR   SAVE IT HERE
007D 4C 3E 8E          JMP   PACKT  CHECK FOR HEX & RETURN
```

# A CLOSE LOOK AT THE SUPERBOARD II

Bruce Hoyt, Pastor
Sharon Associated Reformed Presbyterian Church
Route 1
Brighton, TN 38011

Late in December 1978 my dreams came true. Those dreams I had had in the mid 60's when I first learned how to program computers. I had dreamed of having my own desk-sized computer. That dream has come true to a degree I would not have thought possible then. The computer I now have is not desk-sized but is contained on one printed circuit board. Furthermore it is more powerful than the big monsters I worked on in the mid 60's.

I don't want to bore you with a description of my continual amazement at a computer on a chip for such things are now old hat. Nor do I want to give just a general overview of the Superboard II manufactured by Ohio Scientific. For a general description you may check the March 1979 issue of **Popular Electronics**, p.76. I want to go somewhat deeper into evaluating and describing the Superboard II (Note: the Challenger IP also manufactured by Ohio Scientific is the same computer in a case with power supply).

## HARDWARE

**KEYBOARD:**

The keyboard is mounted directly on the printed circuit board as can be seen in the advertisements. It is a polled keyboard which is polled by writing to a latch addressed at memory location DF00. This latch feeds the rows of the keyboard matrix. When a key is depressed the latch signal is fed through the key switch to a tri-state buffer and back onto the data buss. A read of address DF00 will pick up the signal from the column in which the key is depressed. This method of polling the keyboard makes the hardware very simple (and cheap) but it is effective. In my view a polled keyboard like the one on the Superboard II is better than a hardware implemented ASCII keyboard. Several nice features can be incorporated this way. For example every key has an automatic repeat feature. You have direct access to every key on the board for gaming purposes. Another keyboard can be put in parallel with the existing one. I plan to add a Hex keypad this way. OSI has provided a jack with several of the keyboard lines on it so that switch type joysticks may be connected for games.

For ordinary ASCII input from the keyboard the monitor includes a subroutine which returns the ASCII value of any key depressed. So for all practical purposes this arrangement works just like any other ASCII keyboard.

OSI has fed the signal from the keyboard through a resistor network and then out the game jack. This signal may be connected to a speaker to make sounds or music. The only reason I cannot give a further description of this feature is that OSI failed to include the resistors and I haven't yet gotten around to it.

**VIDEO DISPLAY:**

The video display is elegant and simple from a hardware point of view. The display on the screen is 32 by 32 but has no guard bands. My monitor displays about 27 by 30 screen size. The software supplied with the Superboard uses only 24 character lines since many who buy the Superboard may want to connect it to an ordinary TV through a video modulator. The video display is refreshed from a 1K memory located at D000-D3FF. Any byte written into this memory gets fed through a character generator and then sent to the screen. The character generator produces not only the full set of ASCII symbols but also more than 100 graphics symbols. It is complete enough to do just about anything you would want to on a 24 by 24 screen: Life, Tic-Tac-Toe, Pong, Racecar, Ship-tank-airplane warfare, etc.

You may wonder about the access to the refresh memory since both the CPU and the video disply circuitry must use it. The video display memory is accessed through a multiplexer which is normally connected to the refresh circuitry. This multiplexer allows the CPU to access the memory whenever the CPU addresses any memory from D000to D3FF. This causes a slight blink in the display on the TV monitor but the blink is almost unnoticable. Even constantly writing to the display memory causes only a slight decrease in brightness and some flicker of the picture. But whoever writes constantly to the display memory anyway? There is no affect at all on the monitor when the CPU is accessing memory other than the video memory.

**CASSETTE I/O:**

The Superboard comes with a KC standard cassette interface built in. This operates at 300 baud. That is somewhat slow for loading long programs but the slowness is compensated for by the accuracy. I have yet to find a read error. The hardware for the interface uses a Motorola 6850 ACIA to generate serial data. I think that a small change in the clock used for this ACIA could speed up operation but I have not checked this out yet. This 6850 is located at FOOOFOOI in the memory space.

The greatest difficulty with the cassette interface is that no provision has been made for motor control. It would have been simple to use the Request-to-Send output from the 6850 for this purpose. I plan to connect the Request-to-Send output to a small reed relay for this purpose.

**COMPONENTS:**

The board itself is high quality epoxy-glass. It is double sided, through the hole plated. The CPU is a 6502A and so has plenty of reserve. The RAM chips and other support are mostly low power variety. All have recent date codes. The character generator and the BASIC ROM's are masked programmed type but the monitor is an EPROM. I suppose you could reprogram the Monitor to suit some particular need you might have. The schematics are accurate and clear. They are very easy to follow since this computer is not really very complicated. The only complaint I would have is that various sections of the schematic are not labelled as to their funtion. But with a little study you can figure them out.

**FUTURE EXPANSION:**

An empty 40 pin DIP socket is provided for expansion. All the important control, address, and data lines are connected to this DIP socket. OSI makes a model 610 expansion board which connects to this DIP socket. The 610 expansion board comes with a timer, printer interface, and disk interface along with room for more memory. I personally plan to go from this DIP socket to a KIM type connector for interfacing but there are many possibilities for expansion including the S-100 bus or OSI's 48 pin bus.

## SOFTWARE

**MONITOR:**

The monitor comes in an EPROM at the high end of memory and contains the interrupt vectors, the keyboard input routine, cassette I/O routines, and a memory access routine which allows you to view or change any memory location. With this capability it is very easy to load mchine language programs by hand and then execute them or save them and later load them from tape. One deficiency is the lack of a cassette save routine in the monitor.

The monitor has a load routine but no save routine. I have written a save routine which incorporates a Hex memory dump. (See figure 1) This routine saves data in a format acceptable to the monitor load routine. I have located it at 0222 since this space is unused by the BASIC interpreter. The begin address and the end address of the code to be saved must be entered at 00F7 and 00F9 respectively. When you execute the save routine, be sure to turn on your recorder! The code will be saved on tape as well as displayed on the monitor screen. If you want to use this program as a memory dump just run it without turning on your cassette. Several important monitor routines as well as some Basic routines are listed in Table 1.

**BASIC:**

The BASIC in ROM is an 8K Microsoft product. It is called a 6 digit BASIC since only 6 digits of precision are displayed. Internally, however, all numbers are carried in floating point form with 23 bits of precision (actually the precision is 24 bits since a high order 1 bit is assumed). That amounts to 7½ digits of precision internally. Though this BASIC is very good and very fast it is still a BASIC interpreter and allowance must be made for that fact. I have a puzzle that I have programmed in both BASIC and machine language. The machine language program takes about 1½ hours to run to completion. The BASIC program would take over a month! Superboard is what OSI calls its "immediate mode." That means that any statement can be entered without a line number and it will be executed immediately. Since "?" can be used in place of "PRINT" it is possible to interrogate the computer for any piece of information you might want. For example ? A yields thevalue of the variable A in the memory. ? 45-20 yields 25. ? PEEK (255) yields the contents of memory location 255 in decimal. GOTO 40 sends BASIC to statement number 40 and begins execution at that point. This last feature is very useful in debugging. One could say that the immediate mode allows you to use the Superboard as a super-calculator and provides a built-in debugger. The BASIC alone is worth the price of the computer.

**ASSEMBLER:**

There is one available from OSI on tape but I haven't tried it out. I want to write my own and put it in an EPROM.

**DOCUMENTATION:**

A few words must be said about documentation. Frankly, it is not up to OSI's high quality in the hardware and software areas. The graphics manual is by far the best, providing pretty clear descriptions and giving good examples. The users manual leaves something to be desired in clarity. It is too brief and rather vague at points. I have had real trouble trying to use machine language since there is virtually no description of the machine instructions. I also had some trouble figuring out what pins to connect my cassette to since the diagram is not clearly labelled. The BASIC manual is very brief–admittedly so. OSI expects you to have on hand a BASIC reference manual if you are not thoroughly familiar with the workings of BASIC. One serious problem is an error in the BASIC manual relating to the USR function. It tells you to poke the starting address of the USR routine into locations 023E-023F but this does not work. In the graphics manual there is an example of the use of the USR function. In that example the starting address of the USR routine is poked into 000B-000C. This works. I do wish that manufacturers would supply complete documentation with their software including source code. OSI provides almost nothing in the way of description for either the monitor or BASIC. I have disassembled the monitor and figured it out but have not yet started on BASIC. If anyone has inside information on the inner workings of Superboard BASIC please let us know. Think of all those good routines in BASIC that we could use to memory saving advantage: conversion routines, arithmetic routines, text editor, scanner, etc.

Though I have had to give a few negatives about the Superboard II I am well impressed with the quality of both hardware and software. If you are undecided as to what computer is the best buy for the money, I urge you to send your $279 check to OSI and ask for a Superboard. I don't think there is anything as good for the price on the market.


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OSI CASSETTE SAVE/HEX MEMORY DUMP

BRUCE HOYT
MARCH 1979

TO USE, PLACE THE START ADDRESS OF CODE TO BE SAVED IN 00F7,00F8 AND THEN THE END ADDRESS IN 00F9,00FA. TURN ON THE TAPE RECORDER AND EXECUTE. NOTE: THIS PROGRAM WILL SAVE ITSELF ON TAPE.

```
0222                    ORG   $0222

0222 A9 0D      START   LDAIM $0D     CARRIAGE RETURN
0224 20 2D BF           JSR   $BF2D   CRT
0227 20 7A FF           JSR   $FF7A   10 NULLS TO CASSETTE
022A A9 2E              LDAIM $2E     "." ADDRESS MODE
022C 20 75 02           JSR   CC
022F A5 F8              LDA   $00F8   FROM LOCATION (HIGH)
0231 20 63 02           JSR   AOUT
0234 A5 F7              LDA   $00F7   FROM LOCATION (LOW)
0236 20 63 02           JSR   AOUT
0239 A9 2F              LDAIM $2F     "/" DATA MODE
023B 20 75 02           JSR   CC

023E A2 00      LOOP    LDXIM $00
0240 A1 F7              LDAIX $00F7   GET BYTE
0242 20 63 02           JSR   AOUT    OUTPUT
0245 A9 0D              LDAIM $0D     CARRIAGE RETURN
0247 20 B1 FC           JSR   $FCB1   CASSETTE OUTPUT
024A A9 20              LDAIM $20     SPACE
024C 20 2D BF           JSR   $BF2D   CRT
024F E6 F7              INC   $00F7   INCREMENT FROM ADDRESS
0251 D0 02              BNE   BUMP
0253 E6 F8              INC   $00F8
0255 38         BUMP    SEC           CHECK IF DONE
0256 A5 F9              LDA   $00F9   TO
0258 E5 F7              SBCZ  $00F7   FROM
025A A5 FA              LDA   $00FA   TO + 1
025C E5 F8              SBCZ  $00F8   FROM + 1
025E 10 DE              BPL   LOOP
0260 4C 43 FE           JMP   $FE43   YES, RETURN TO MONITOR

0263 85 FC      AOUT    STA   $00FC   USE MONITOR DISPLAY
0265 20 AC FE           JSR   $FEAC   TO UNPACK
0268 AD CC D0           LDA   $D0CC   HI
026B 20 75 02           JSR   CC
026E AD CD D0           LDA   $D0CD   LO
0271 20 75 02           JSR   CC
0274 60                 RTS

0275 20 B1 FC   CC      JSR   $FCB1   OUTPUT TO CASSETTE
0278 20 2D BF           JSR   $BF2D   AND CRT
027B 60                 RTS
```

Figure 1

Page 0 Usage

| | |
|---|---|
| 0000 | JMP to warm start in BASIC |
| 00FB | cassette/keyboard flag for monitor |
| 00FC | data temporary hold for monitor |
| 00FE-00FF | address temporary hold for monitor |

Page 1

| | |
|---|---|
| 0100-0140 | stack |
| 0130 | NMI vector - NMI interrupt causes a jump to this point |
| 01C0 | IRQ vector |

Page 2

| | |
|---|---|
| 0200 | cursor position |
| 0203 | load flag |
| 0205 | save flag |
| 0206 | CRT simulator baud rate - varies from 0 = fast to FF = slow |
| 0212 | Control-C flag |
| 0218 | input vector = FFBA |
| 021A | output vector = FF69 |
| 021C | Control C check vector = FF9B |
| 021e | load vector = FF8B |
| 0220 | save vector = FF96 |
| 0222-02FA | unused |

Page 3 and up to end of RAM is BASIC workspace

| | |
|---|---|
| A000-BFFF | BASIC in ROM |
| D000-D3FF | Video refresh memory |
| DF00 | Polled keyboard |
| F000-F001 | Cassette port 6850 |
| F800-FFFF | Monitor EPROM |
| FC00 | Floppy bootstrap |
| FD00 | Keyboard input routine |
| FE00 | Monitor |
| FF00 | BASIC I/O support |

Useful Subroutine entry points

| | |
|---|---|
| A274 | warm start for BASIC |
| BD11 | cold start for BASIC |
| BF2D | CRT simulator - prints char in A register |
| FD00 | input char from keyboard, result in A |
| FCB1 | output 1 byte from A to cassette |
| FE00 | entry to monitor, clears screen, resets ACIA |
| FE0C | entry to monitor, bypasses stack initialization |
| FE43 | entry to address mode of monitor |
| FE80 | input ASCII char from cassette, result in A, 7 bit cleared |
| FE93 | convert ASCII hex to binary, result in A, =80 if bad |
| FF69 | BASIC output to cassette routine, outputs one char to cassette, displays on screen, outputs 10 nulls if carriage return character |
| FF00 | Reset entry point |
| FF8B | Load flag routine |
| FF96 | Save flag routine |
| FF9B | Control-C routine |
| FFBA | BASIC input routine |

Table 1.

**EKIM OR MAXI-KIM**
**Extended Keyboard Input Monitor**

Andrew V.W. Sensicle
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Quebec, Canada H9R 4B8

Although KIM-1's ROM contains useful features like the tape and TTY input-output routines, when it comes to inputting data or coding via the key pad, KIM's resident monitor leaves much to be desired, for example the avoidance of repetitive pushing of the "↑" between each entry or the ability to look back a few bytes without going into address mode. I would like to thank Jim Butterfield for his excellent BROWSE and BRANCH PROGRAMS which I put together in Page 1 and have used religiously since I got started in this game in mid '78.

However, these have their limitations and I have frequently found the need for a little more sophistication, not to mention the space they occupy in Page 1. Anyway the thing which irritated me most was the need to re-enter a long listing merely in order to open up a few spaces for additional instructions. The process of tidying up a finished program, entailing closing up unwanted spaces and the associated readdressing was also very time consuming.

I thus decided to try to write an extended monitor which would be compact enough to fit in Page 17 and yet provide the functions I needed. After much condensing and compressing I ended up with a program 6 bytes longer than the "legal" Page 17 RAM, but by stealing a little from KIM it fits nicely. KIM doesn't seem to mind. As long as you don't use the tape or TTY routines, he leaves you alone.

The **NMI** vector is loaded with the start address (1780) so that the **ST** key can be used to access the monitor at any open cell address. Before pressing **ST** or after exitting via **RS** the resident monitor is used as a normal in the **AD** mode. The **ST** key gives you 6 other modes of operation or functions.

1. **STAND BY MODE [ST]:** This starts the program which then sits looking at the open cell address and its contents, ie. nothing seems to happen. However, any HEX key is stored at the open cell address which each second key stroke increments the address.

2. **INCREMENT [↑]:** Big deal! This works just like normal.

3. **DECREMENT [PC]:** This steps the address points backwards exactly the reverse of "↑".

4. **OPEN UP MODE [AD]:** Each depression of this key causes one full page of bytes (FF) to be moved one place up starting at the open cell address.

5. **CLOSE UP MODE [DA]:** Each depression of this key causes one full page of bytes to be moved one place back to overwrite the open cell contents. Having made an "open up" or close up move of one or more steps you will, of course, have to fix up all affected addresses. This is not as onerous as it sounds if you use the sixth mode.

6. **BRANCH MODE [GO]:** When a branch instruction is encountered while entering a new program or fixing up an old one, all you need do is press "GO" followed by the actual destinction address (low order only). The monitor will calculate the relative address, store it in the open cell and step on to the next cell all in the twinkling of an eye. The user is, as usual, responsible for ensuring that the branch does not exceed the normal half page range.

I hope that this little program will be as useful to others as it is and has been to me.

```
                        ORG    $1780

MODE    *       $00FF
TEMPX   *       $00FD
LAST    *       $00F3
INL     *       $00F8
POINTL  *       $00FA
POINTH  *       $00FB

SCAND   *       $1F19
GETKEY  *       $1F6A
UPDATE  *       $1FBB
INCPT   *       $1F63

1780 D8         START   CLD
1781 A2 01              LDXIM  $01      INITIATE MODE AND
1783 86 FF              STX    MODE     COUNTER
1785 86 FD              STX    TEMPX
```

```
1787 20 19 1F  GETK    JSR    SCAND   LIGHT DISPLAY
178A 20 6A 1F          JSR    GETKEY  CHECK KEYS
178D C5 F3             CMP    LAST
178F F0 F6             BEQ    GETK
1791 85 F3             STA    LAST    NEW KEY
1793 C9 13             CMPIM  $13     GO ?
1795 D0 02             BNE    SKIP
1797 C6 FF             DEC    MODE    PUT IN BRANCH MODE
1799 C9 12      SKIP   CMPIM  $12     + ?
179B F0 4A             BEQ    INCPNT
179D C9 14             CMPIM  $14     PC ?
179F F0 22             BEQ    DECPNT
17A1 C9 11             CMPIM  $11     DA ?
17A3 F0 11             BEQ    CLOSUP
17A5 C9 10             CMPIM  $10     AD ?
17A7 D0 26             BNE    INDATA

17A9 A0 FF      OPENUP LDYIM  $FF     LOAD 255(10)
17AB 88         OPENX  DEY
17AC B1 FA             LDAIY  POINTL  LOAD AND STORE
17AE C8                INY            ONE CELL HIGHER
17AF 91 FA             STAIY  POINTL
17B1 88                DEY
17B2 D0 F7             BNE    OPENX   NEXT
17B4 F0 CA             BEQ    START

17B6 A0 01      CLOSUP LDYIM  $01
17B8 B1 FA      CLOSY  LDAIY  POINTL  LOAD OPEN CELL
17BA 88                DEY            PLUS 1
17BB 91 FA             STAIY  POINTL  STORE IN OPEN CELL
17BD C8                INY            THEN UP
17BE C8                INY            UNTIL
17BF D0 F7             BNE    CLOSY
17C1 F0 BD             BEQ    START   CONE 255 (10)

17C3 C6 FA      DECPNT DEC    POINTL
17C5 A5 FA             LDA    POINTL
17C7 C9 FF             CMPIM  $FF     PAGE CHANGE?
17C9 D0 B5             BNE    START   NO
17CB C6 FB             DEC    POINTH  YES, THEN DEC POINTH
17CD 10 B1             BPL    START   AS WELL

17CF C9 10      INDATA CMPIM  $10
17D1 B0 AD             BCS    START   FALSE START ACTUALLY NO KEY
17D3 20 BB 1F          JSR    UPDATE  ROL 4 BITS FROM A TO INL
17D6 A5 F8             LDA    INL
17D8 91 FA             STAIY  POINTL
17DA C6 FD             DEC    TEMPX
17DC F0 A9             BEQ    GETK    ONE MORE KEY
17DE A4 FF             LDY    MODE    IN BRANCH MODE?
17E0 D0 05             BNE    INCPNT  NO
17E2 18                CLC
17E3 E5 FA             SBC    POINTL  CALC RELATIVE ADDRESS
17E5 91 FA             STAIY  POINTL  STORA IT IN OPEN CELL
17E7 20 63 1F  INCPNT  JSR    INCPT   NEW CELL
17EA 4C 80 17          JMP    START   RETURN
```

# A CASSETTE OPERATING SYSTEM FOR THE APPLE II

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Dayton, OH 45431

Have you ever wished that as great as the Apple II computer system is that you were able load programs by name from a library cassette? Well, with this mini-sized cassette operating system you can stack many programs on one cassette and load the one you want by typing in its name. Great for showing off your system without juggling a dozen or so cassette tapes.

The **Cassette Operating System [CASSOS]** resides in memory at locations 02C0 to 03FF, where it won't get clobbered by BASIC programs or initalization. Add the optional cassette control circuit, or purchase one of the commercially available ones. (Candex Pacific, 693 Veterans BLVD, Redwood City, CA 94063) and you never need envy the PET for its loading technique again.

## Operation

Load the 'CASSOS' tape, which you have created from the assembly listing, just like any other machine language program (2C0.3FFR), then initalize the BASIC pointers by depressing CTRL-B, return. To load a program depress CTRL-Y and RETURN. "PROG?" will be displayed, enter a 1-10 character program name. The cassette tape will be searched and the program loaded if found. "XXXXXXXXXX LOADED" will be output, where XXXXXXXXXX is the program now in memory. If the cassette control circuit (described later) is present the tape will also be stopped. A line of question marks (??????????) are displayed if the requested program was not found. To write a program to the library cassette enter Yc (Ctrl-Y, "WRITE", and RETURN. Program will be saved under the name requested at PROG? . "XXXXXXXXXX OUT" will be displayed at completion and the recorder stopped. To end a cassette program file enter: Yc, "EOF", RETURN; a special record header will be written. Note that to conserve limited memory space the EOF routine utilizes the program write subroutine so the "XXXXXXXXXX OUT" message should be ignored.

The program is structured such that the last 63 locations of the input buffer is used for display messages, so if more than 191 characters are entered at one time the program will still function, but without messages. The listing as presented was for a 16K system, change location 0358 as follows for a different configuration:

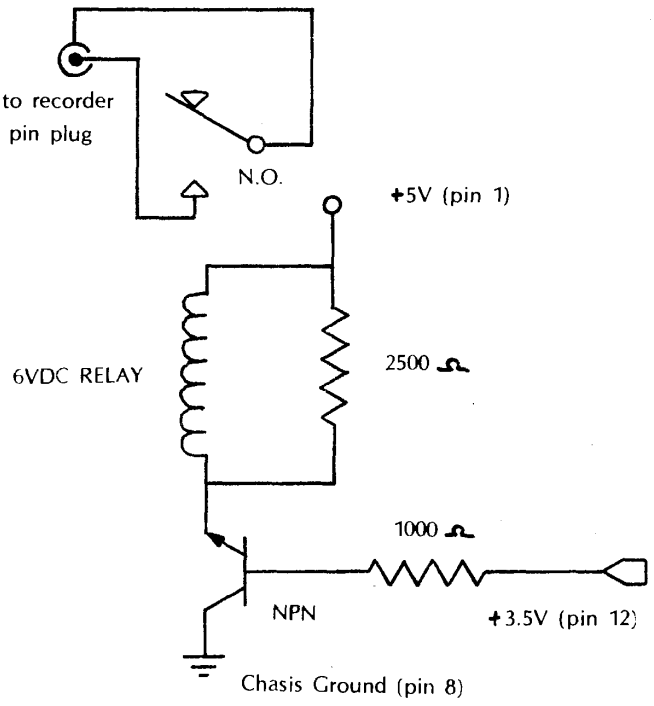
| | |
|---|---|
| 2F-8K | 6F-24K |
| 3F-12K | 8F-32K |
| 4F-16K | 9F-36K |
| 5F-20K | CF-48K |

## Program Design

The method by which CASSOS functions is to write a program header block consisting of header ID, program name, and start of the BASIC load. This is followed by the program data itself, utilizing the Apple monitor routines.

## A Cassette On/Off Circuit

The following diagram describes a simple circuit for stopping and starting a cassette recorder which has a "remote" plug from the Apple II under program control. The theory involves activating or deactivating the AN3 signal on the Apple game connector. A store to location CO5F turns the recorder on and location CO5E turns it off. The strobe triggers a transistor which in turn opens a relay and closes the connection to the remote plug, starting the recorder. If your recorder requires an open connection to start tape movement wire the relay normally closed instead of open. It is also possible to add a relay that would interupt power to the recorder for control if you have no remote capability on your recorder.




**Cassette Control Circuit**

## Parts List

All parts were purchased at a local Radio Shack
- 6VDC Relay (275-004)
- NPN Transistor (2N3568 or equivalent)
- 1000 Ohm Resistor
- 2500 Ohm Resistor
- Mini-Plug

All connections were made to a DIP Header which was modified by soldering a 16-pin IC to it so that the game paddles could still be used without modification when the cassette ON/Off circuit was in use. The common 6VDC relay was modified to be triggered by the game connector signals by wiring a 2500 ohm resistance (utilizing a series of resistors connected in series so that the sum is 2500 Ohms) in parallel with the relay coil. If your recorders rewind controls are disabled by the remote jack wire a switch to bypass the transistor between chasis ground and the relay, which will allow the rewind to operate when depressed. If all this is beyond your scope use the purchased control or simply stop and start the recorder manually.

```
02C0-   A9 D3       LDA   #$D3
02C2-   8D B0 02    STA   $02B0
02C5-   A9 B1       LDA   #$B1
02C7-   20 67 03    JSR   $0367
02CA-   A9 FF       LDA   #$FF
02CC-   8D BB 02    STA   $02BB
02CF-   A5 CA       LDA   $CA
02D1-   8D BC 02    STA   $02BC
02D4-   A5 CB       LDA   $CB
02D6-   8D BD 02    STA   $02BD
02D9-   20 CD FE    JSR   $FECD
02DC-   A4 CA       LDY   $CA
02DE-   A5 CB       LDA   $CB
02E0-   20 60 03    JSR   $0360
02E3-   20 CD FE    JSR   $FECD
02E6-   A9 EB       LDA   #$EB
02E8-   20 7E 03    JSR   $037E

02EB- 87 A0 CF D5 99
02F0- FF 87 A0 CC CF C1 C4 C5
02F8- C4 FF D0 D2 CF C7 BF FF


0300-   A2 02       LDX   #$02
0302-   D0 07       BNE   $030B
0304-   84 60       STY   $60
0306-   20 62 FC    JSR   $FC62
0309-   A4 60       LDY   $60
030B-   8E 15 03    STX   $0315
030E-   8C 14 03    STY   $0314
0311-   A0 00       LDY   #$00
0313-   B9 FA 02    LDA   $02FA,Y
0316-   C9 FF       CMP   #$FF
0318-   F0 2D       BEQ   $0347
031A-   20 ED FD    JSR   $FDED
031D-   C8          INY
031E-   D0 F3       BNE   $0313
0320-   48          PHA
0321-   A9 02       LDA   #$02
0323-   86 60       STX   $60
0325-   85 61       STA   $61
0327-   A9 A0       LDA   #$A0
0329-   20 6C FD    JSR   $FD6C
032C-   68          PLA
032D-   AA          TAX
032E-   A0 00       LDY   #$00
0330-   B9 00 02    LDA   $0200,Y
0333-   C9 8D       CMP   #$8D
0335-   F0 08       BEQ   $033F
0337-   91 60       STA   ($60),Y
0339-   C8          INY
033A-   CA          DEX
033B-   F0 0A       BEQ   $0347
033D-   D0 F1       BNE   $0330
033F-   A9 A0       LDA   #$A0
0341-   91 60       STA   ($60),Y
0343-   C8          INY
0344-   CA          DEX
0345-   D0 F8       BNE   $033F
0347-   60          RTS
0348-   A0 B0       LDY   #$B0
034A-   A2 00       LDX   #$00
034C-   20 51 03    JSR   $0351
034F-   A0 BD       LDY   #$BD
0351-   A9 02       LDA   #$02
0353-   D0 04       BNE   $0359
0355-   A0 FF       LDY   #$FF
0357-   A9 3F       LDA   #$3F
0359-   95 3D       STA   $3D,X
035B-   94 3C       STY   $3C,X
035D-   E8          INX
035E-   E8          INX
035F-   60          RTS
0360-   A2 00       LDX   #$00
0362-   20 59 03    JSR   $0359
0365-   D0 EE       BNE   $0355
0367-   85 50       STA   $50
0369-   A2 02       LDX   #$02
036B-   A0 FA       LDY   #$FA
036D-   20 04 03    JSR   $0304
0370-   20 48 03    JSR   $0348
0373-   A9 0A       LDA   #$0A
0375-   A6 50       LDX   $50
0377-   20 20 03    JSR   $0320
037A-   8D 5F C0    STA   $C05F
037D-   60          RTS
037E-   48          PHA
037F-   8D 5E C0    STA   $C05E
0382-   A2 02       LDX   #$02
0384-   A0 B1       LDY   #$B1
0386-   20 04 03    JSR   $0304
0389-   68          PLA
038A-   A8          TAY
038B-   20 00 03    JSR   $0300
038E-   4C 03 E0    JMP   $E003
0391-   A9 A3       LDA   #$A3
0393-   20 67 03    JSR   $0367
0396-   20 48 03    JSR   $0348
0399-   20 FD FE    JSR   $FEFD
039C-   AD B0 02    LDA   $02B0
039F-   C9 D3       CMP   #$D3
03A1-   D0 29       BNE   $03CC
03A3-   AC BC 02    LDY   $02BC
03A6-   AD BD 02    LDA   $02BD
03A9-   20 60 03    JSR   $0360
03AC-   20 FD FE    JSR   $FEFD
03AF-   A2 00       LDX   #$00
03B1-   BD B1 02    LDA   $02B1,X
03B4-   DD A3 02    CMP   $02A3,X
03B7-   D0 DD       BNE   $0396
03B9-   E8          INX
03BA-   E0 0A       CPX   #$0A
03BC-   D0 F3       BNE   $03B1
03BE-   AD BC 02    LDA   $02BC
03C1-   85 CA       STA   $CA
```

```
03C3-  AD BD 02    LDA   $02BD      03E3-  F0 10       BEQ   $03F5
03C6-  85 CB       STA   $CB        03E5-  C9 C5       CMP   #$C5
03C8-  A9 F1       LDA   #$F1       03E7-  D0 A8       BNE   $0391
03CA-  D0 B2       BNE   $037E      03E9-  8D B0 02    STA   $02B0
03CC-  8D 5E C0    STA   $C05E      03EC-  20 48 03    JSR   $0348
03CF-  A2 20       LDX   #$20       03EF-  8D 5F C0    STA   $C05F
03D1-  A9 BF       LDA   #$BF       03F2-  4C CA 02    JMP   $02CA
03D3-  20 ED FD    JSR   $FDED      03F5-  4C C0 02    JMP   $02C0
03D6-  CA          DEX              03F8-  4C DE 03    JMP   $03DE
03D7-  D0 F8       BNE   $03D1      03FB-  00          BRK
03D9-  20 DD FB    JSR   $FBDD      03FC-  00          BRK
03DC-  F0 B3       BEQ   $0391      03FD-  00          BRK
03DE-  AD 01 02    LDA   $0201      03FE-  00          BRK
03E1-  C9 D7       CMP   #$D7       03FF-  00          BRK
```

**A Cassette Tape Catalog**

Shown in exhibit is a short integer BASIC program which when loaded will list all the programs on a CASSOS format library tape. The CASSOS sub-routines are used so the software must be core resident. Just load the program, insert the library cassette into the cassette handler, and type RUN after starting the cassette player.

```
 10 N=1: CALL -936: VTAB (10): DIM X$(1)
 20 INPUT "INSERT LIBRARY TAPE AND DEPRESS 'RETURN'";X$
 30 POKE -16289,0: CALL -936: GOSUB 300
 40 PRINT "FILE #  PROGRAM NAME  BYTES"
 50 PRINT "------  ------------  -----"
 60 CALL 840: CALL -259
 70 IF PEEK (688)= ASC("E") THEN 210
 80 IF PEEK (688)# ASC("S") THEN 200
100 REM  LOAD INTO NON-EXIST MEMORY (800-BFF)
110 POKE 60, PEEK (700): POKE 61,( PEEK (701)+128)
120 POKE 62,255: POKE 63,191: CALL -259
130 PRINT N,: POKE 789,2: POKE 788,177: CALL 785
140 L= PEEK (700)+ PEEK (701)*256
150 L=16384-L:N=N+1
160 PRINT "     ";L: GOTO 60
200 GOSUB 300: PRINT "NO EOF MARK"
210 POKE -16290,0: GOSUB 300
230 PRINT "***END OF FILE***"
240 CALL -155
300 FOR I=1 TO 30
305 L= PEEK (-16336)+ PEEK (-16336): NEXT I
310 CALL -1059: RETURN
```

```
>RUN
INSERT LIBRARY TAPE AND DEPRESS 'RETURN'

FILE #  PROGRAM NAME  BYTES
------  ------------  -----
1DIRECTORY      544
2BILLBOARD      238
3R.ROULETTE     530
4COLORBYROD     185
5HELLO          2830
6BOWLING        2119
7BOXING         2636
8TICTACTOE      3461
***END OF FILE***
```

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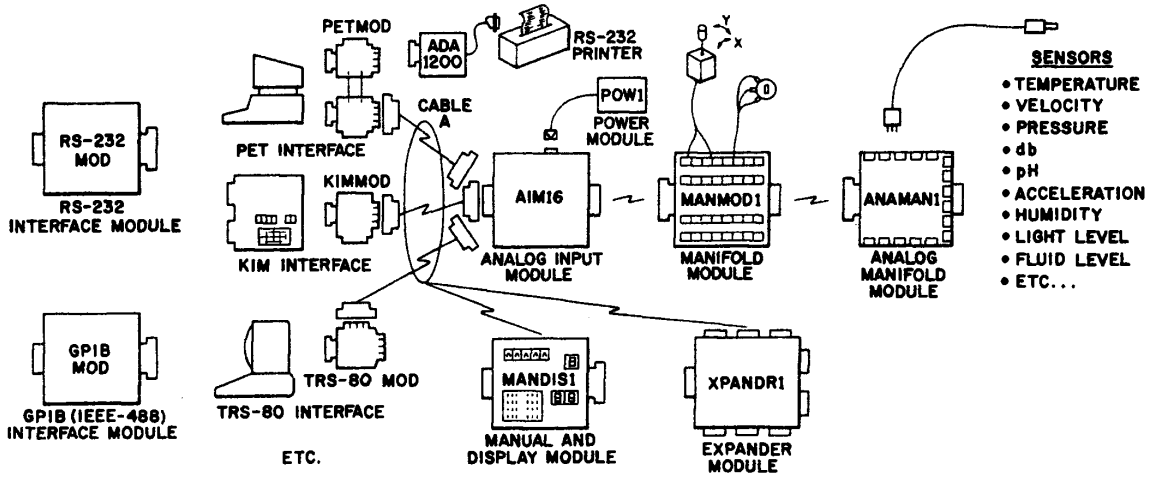
DAM SYSTEMS

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## DAM SYSTEMS PRICE LIST

### DAM SYSTEMS components

**AIM161 - Analog Input Module** — $179.00
16 8-bit analog inputs - 100 microsecond conversion time - 3 state output - requires one 8-bit computer output port for control and one 8-bit computer input port for data.

**AIM162 - Analog Input Module** — $249.00
As above plus: greater accuracy - gold plated contacts - pilot light - switch selectable start, enable and reads polarities.

**POW1 - Power Module** — $14.95
Supplies power for one AIM16 module.

**ICON - Input Connector** — $9.95
For connecting analog inputs to the AIM16 - 20 pin card edge connector - solder eyelets.

**OCON - Output Connector** — $9.95
For connecting the AIM16 to a computer - 20 pin card edge connector - solder eyelets.

**MANMOD1 - Manifold Module** — $59.95
Use in place of ICON. Screw terminal barrier strips for connecting joysticks, potentiometers, voltage sources, etc. Eliminates the need for soldering. Plugs into the AIM16.

**ANAMAN1 - Analog Manifold Module** — TBA
Use in place of ICON. Connects DAM SYSTEMS SENSORS to the AIM16 without soldering - sensor cables just plug in. Plugs into the AIM16 or the MANMOD1.

**SENSORS** — TBA
Sensors for temperature, pressure, flow, humidity, level, pH, motion, etc.

**COMPUTER INTERFACES** — TBA
For the PET, KIM, TRS-80, etc. Use in place of OCON. Eliminates the need for soldering or special construction.

**PETMOD - PET Interface Module** — $49.95
Gives two IEEE ports, one user port and one DAM SYSTEMS interface port. Saves wear and tear on the PET's printed circuit board. Also called the PETSAVR.

**KIMMOD - KIM Interface Module** — $39.95
Gives one application connector port and one DAM SYSTEMS interface port.

**CABLE "A" - Interconnect Cables** — TBA
Connects computer interface to AIM16, MANDIS1, XPANDR1, etc.

**CABLE A24 - Interconnect Cable** — $19.95
24 inch cable with interface connector on one end and an OCON equivalent on the other.

**MANDIS1 - Manual and Display Module** — TBA
Connects between the AIM16 and the computer interface. Allows manual or computer control of the AIM16. Displays channel number and data.

**GPIB MOD - GPIB (IEEE-488) Interface** — TBA
Allows the DAM SYSTEMS MODULES to be used with the GPIB bus instead of a computer's other I/O ports.

**RS232 MOD - RS232 Interface Module** — TBA
Allows the DAM SYSTEMS MODULES to be used with an RS-232 port or terminal.

**XPANDR1 - Expander Module** — TBA
Allows up to 128 8-bit analog inputs (8 AIM16 Modules) to be connected to one system.

### DAM SYSTEMS sets

**AIM161 Starter Set** — $189.00
Includes one AIM161, one POW1, one ICON and one OCON.

**AIM162 Starter Set** — $259.00
Includes one AIM162, one POW1, one ICON and one OCON.

**PETSET1a** — $295.00
Includes one PETMOD, one CABLE A24, one AIM161, one POW1 and one MANMOD1.

**KIMSET1a** — $285.00
Includes one KIMMOD, one CABLE A24, one AIM161, one POW1 and one MANMOD1.

## ASK THE DOCTOR - PART III
## BITS AND BYTES

Robert M. Tripp, Ph.D.
The COMPUTERIST, Inc.
P.O. Box 3
So. Chelmsford, MA 01824

The Doctor was busy this month and did not get a chance to write up the EPROM Programmer hardware as promised in the last issue. Look for it next time. A couple of people did submit some good info which is printed below. The Doctor encourages such input. Too much is happening with these new computers for anyone person to "know it all", so if you find out something interestng, please drop us a note and let us get the word out.

### Corrected AIM SYNC Program

The early AIM User Manuals had a number of mistakes, as is to be expected the first batch. One of the more serious errors was in the listing for the SYN Write and SYN Read programs on page 9-11. The errors have been corrected in later versions of the manual, but for those of you who need the programs, here they are - corrected.

SYN Write Program:

```
0300  20 1D F2   JSR F21D
0303  20 4A F2   JSR F24A
0306  4C 03 03   JMP 0303
```

SYN Read Program:

```
0310  A2 00      LDX #00
0312  A9 CE      LDA #CE
0314  20 7B EF   JSR EF7B
0317  20 EA ED   JSR EDEA
031A  A2 00      LDX #00
031C  A9 D9      LDA #D9
031E  20 7B EF   JSR EF7B
0321  20 29 EE   JSR EE29
0324  C9 16      CMP #16
0326  F0 F9      BEQ 0321
0328  D0 E6      BNE 0310
```

### Patch for the AIM-DISASSEMBLER

It soon becomes obvious, that the disassembler is extremely paper consuming, because no single-stepping is provided. The following program will save you money and time!

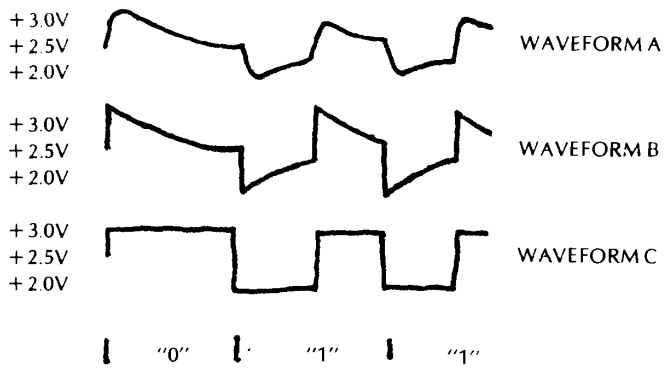
Set F1 (010C) to 'JMP 03D9' and F2 (010F) to 'JMP 03CB'. After loading the desired program address (*), hitting **F1** will dissable just this line on the display. To advance, press the space-bar. If you want to modify, use 'I' and the program jumps to the **Instruction Mnemonic Entry.** The current address will not be changed. **'ESC'** brings you back to the AIM—Monitor. With **'F1'**, the next address will be disassembled. **'F2'**, however, will substract the last used op-code length from the current address and then disassemble the last entry! It is even possible to disassemble further "backwards", just keep switching from **'ESC'** to **'F2'**. Of course, a change in the op-code length will bring up some unexpected results, but very soon you'll catch a proper op-code again!

```
03CB  AD 25 A4   LDA A425
03CE  18         CLC
03CF  E5 EA      SBC EA
03D1  8D 25 A4   STA A425
03D4  B0 03      BCS 03D9
03D6  CE 26 A4   DEC A426
03D9  20 24 EA   JSR EA24
03DC  20 6C F4   JSR F46C
03DF  20 07 E9   JSR E907
03E2  20 3C E9   JSR E93C
03E5  C9 49      CMP #49
03E7  D0 03      BNE 03EC
03E9  4C 9E FB   JMP FB9E
03EC  C9 20      CMP #20
03EE  D0 F2      BNE 03E2
03F0  AD 25 A4   LDA A425
03F3  38         SEC
03F4  65 EA      ADC EA
03F6  8D 25 A4   STA A425
03F9  90 DE      BCC 03D9
03FB  EE 26 A4   INC A426
03FE  90 D9      BCC 03D9
```

Submitted by
Gebhard Brinkmann
Koblenzer Str. 1.
D-5401 Kaltengers
West Germany

### SYM Tape Evaluation

As a result of our telephone conversation on Monday, I decided to look for any possible hardware problems in the SYM Cassette Interface. Some results are shown below. Whether these are related to your cassette problems is unknown. In checking my Sony TC-62, I found an unexpected very slow acting AVC (increases gain very slowly, decreases rapidly). This could cause problems in a level sensitive system as the gain slowly increases during the recording process to a quite large degree.




740 usec
wide

All waveforms taken at PIN 3 of the LM311 (U26) with a sync tape generation program running (hi-speed). Audio OUt (HI) is connected directly to Audio In (A-P to A-L).

WAVEFORM A is the normal condition as received (VIM 80650912 E/C0003)
WAVEFORM B is with C14 (.0047uF) removed
WAVEFORM C is with C14 removed and C16(.01uF) paralled with 1uF

CONCLUSION: C16 is much too small and could easily cause the system to become marginal in the presence of noise and normal level variations. C14 has no apparent real value and seems to unnecessarily increase transition time uncertainty. The small value of C16 and the presence of C14 together simulate the waveform degradation of a very limited bandwidth recorder. Their effect augment rather than compensate for the deficiencies of a recorder. Suprisingly, it appears that it would be a recorder with poor low, rather than high, frequency response which would be most likely to have problems with C16 is maintained at its original .01 microfarad value.

Submitted by
Don Lloyd
101 Western Ave., Apt. 76
Cambridge, Ma. 02139

**F L A S H ! ! !**

Synertek has finally solved the sensitivity problem which has been of concern to users of the tape cassette, according to a spokesman from Synertek Systems. I have sent them a pair of 2716 EPROMs to be programmed with the new monitor. If these are returned in time, I will make a full report in next month's issue.

**Comments on Synertek BASIC (8K) V1.1**

1) 2 ROM's, U21, U22, C000-DFFF, (J) (0) (CR to start BASIC
2) **Commands** - CLEAR, LIST, NULL, RUNN, NEW CONT, LOAD "A", SAVE "A"
3) **Statements** - DATA, DEF, DIM, END FOR, GOTO, GOSUM, IF.. GOTO, IF...THEN, INPUT, LET, NEXT, ON.. GOSUM, POKE, PEEK, PRINT, READ, REM, RESTORE, RETURN, STOP, WAIT.
4) **Functions** - ABS(X), INT(X), RND(X), SGN(X), SQR(X), TAB(I), USR(I), USR(I,J,...Z), EXP(X), FRE(X), LOG(X), POS(I), SPC(I)
SIN(X), COS(X), TAN(X), ATN(X) all must be loaded separately - App Note 53-SSC not quite available.
5) **Strings** - DIM A$, LET A$, INPUT X$, READ X$, PRINT X$
6) **String Functions** - ASC(X$), CHR$(I), FRE(X$), LEFT$(X$,I) LEN(X$), MID$(X$,I), MID$(X$,I,J), RIGHT$ (X$,I), STR$(X), VAL(X$)
7) **Operators** =,-,+, exponentiation, *,=, (not equal), , , (LTE), (GTE), NOT, AND, OR
8) **Uses Memory** from 0200 HEX up until ROM or no memory, unless restricted at start up.
9) **Weaknesses** - Only editing is delete line, delete last character (RUB-OUT), no ROM TRIG, no program merging capability.
10) **Strengths** - Good array features (but no MAT functions), 9 digit accuracy floating points
4 byte floating point numbers
7 bits + 1 bit sign exponent
1 bit sign + 24 bit binary value (**M$**bit = 1 always)
& "000F" = 15 decimal
hex string conversion to decimal
USR (I,J,...Z) Machine language subroutine multiple parameters on stack result (A,Y)

Speed is comparable to OSI Kilobaud Oct '77 ratings (1MHz) Overall subjective by infrequent BASIC user: 7.5/10 seems appropriate to overall product.

Submitted by
Don Lloyd
101 Western Ave., Apt. 76
Cambridge, Ma. 02139

**EPROM PROGRAMMER**

**Software available for F-8, 6800, 8080, 8085, Z-80, 6502, KIM-1, 1802.**

The EP-2A-79 will program the 2704, 2708, TMS 2708, 2758, 2716, TMS 2516, TMS 2716, TMS 2532, and 2732. PROM type is selected by a personality module which plugs into the front of the programmer. Power requirements are 115 VAC, 50/60 HZ at 15 watts. It is supplied with a 36-inch ribbon cable (14 pin plus) for connecting to microcomputer. Requires 1 ½ I/O ports.

**Assembled and tested $145, Plus $15-25 for each personality module. Specify software.**

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**RENUMBER** — Will renumber your BASIC programs, including all jump statements. For a 6K source code requires less than 5 seconds ..... **$12.95**

**PILOT** — A BASIC coded PILOT interpreter. A second high level language for the PET. Simple to use, even a ten year old can learn to use PILOT quickly. With sample PILOT programs and documentation ..... **$12.95**

**CHECKBOOK** — Will baiance your checkbook and save totals in 16 categories on tape. Will produce end of month and year to date summaries. Categories can easily be changed to suit your own purposes..... **$12.95**

**MAIL LIST** — Keeps a mailing list and will sort the list into sub groups using up to three search parameters ..... **$12.95**

All of our programs are available on tape or for the Compu-Think disk. We charge $5.00 for the disk and shipping, but you can subtract $1.00 for each program which we place on the disk. Order 5 programs and you get the disk free!

**MAIL LIST** — The above program has been modified for disk files. Will be placed on a disk by itself which you can then use for your mailing list ..... **$19.95**

**FLASH!** — We have just acquired the rights to distribute a linking loader for BASIC programs! This will allow you to link exclusively numbered BASIC subroutines in memory. No serious programmer should be without this useful programming tool..... **$12.95**

An ideal companion to the linking loader will be our library of useful subroutines which can be linked into your own program. Currently over 25 useful routines are included. These range from plotting utilities to a beautiful display of rolling dice. Write or call for a list or order the set for only..... **$49.95**

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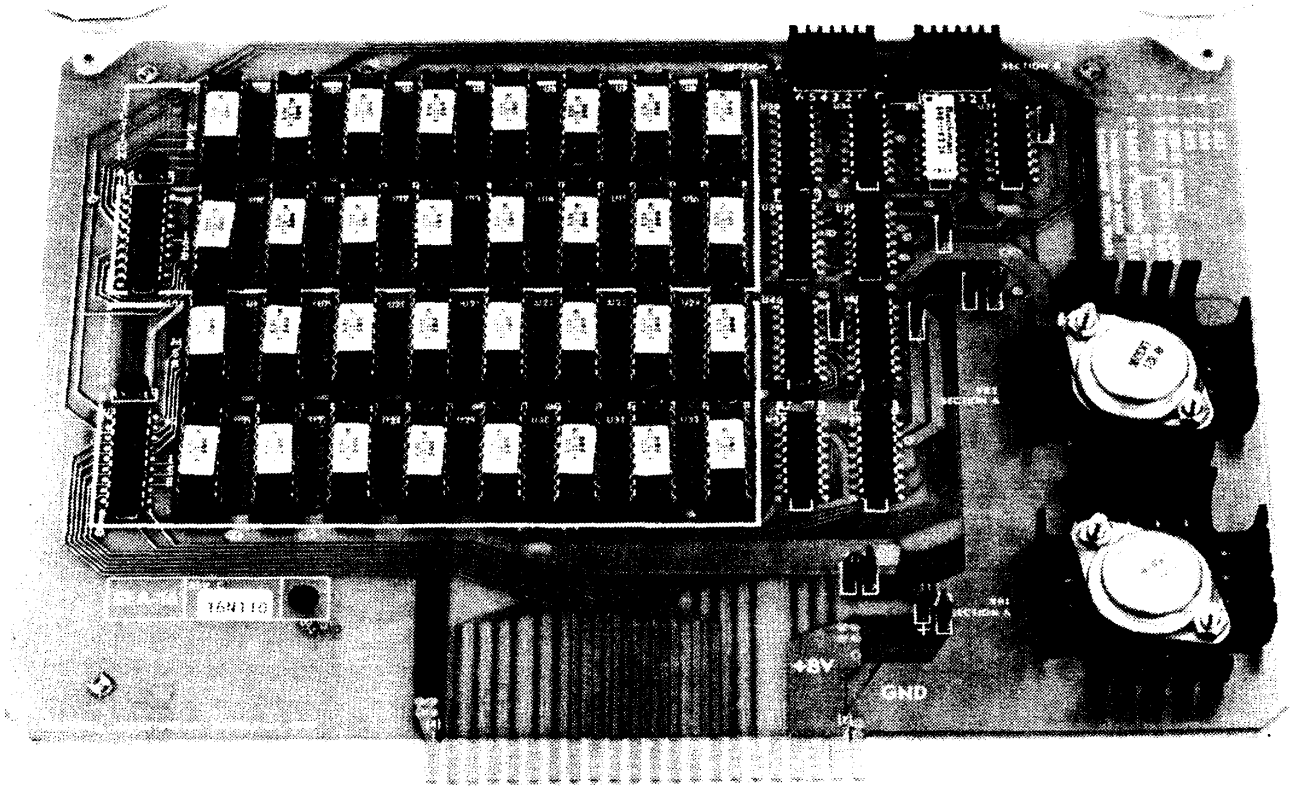


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# THE MICRO SOFTWARE CATALOG: VII

Mike Rowe
P.O. Box 3
S. Chelmsford, MA 01824

Name: Slow-Scan Television Package
System: Apple II
Memory: 16K (min)
Language: Machine Language
Hardware: Standard Apple II
Description: This software system allows the Apple II to send and receive U.S. amateur standard slow-scan T.V. pictures (120 line-15 Hz) via any ham radio SSB transceiver. A real-time display of the received picture in high-resolution graphics is accomplished with a sophisticated image processing algorithm. Low-resolution images for transmission are prepared with a large-character display editor as well as a drawing editor. All modulation and demodulation of the audio FM subcarrier is performed by the software — replacing hundreds of dollars of hardware required by other SSTV systems. Comes on cassette with 8 mins. of test pictures.
Copies sold: about 100
Price: $20.
Includes: Cassette tape and 5 pages of documentation.
Author: Chris H. Galfo — WB4JMD
Available from:
C.H. Galfo
602 Orange St
Charlottesville, VA 22901

Name: S-C Assembler II (disk version)
System: Apple II with at least one disk
Memory: 24K or more
Hardware: Apple II, Disk II, optional printer
Description: Disk version of the popular S-C Assembler for the Apple II. Combines a text editor and an assembler in one memory resident package of 3072 bytes (1000-1BFF). Carefully integrated with the Apple II ROM-resident routines, and with Apple DOS. Editor includes full screen-editing, BASIC-like line number editing, tab stops, and renumbering. LOAD and SAVE commands for storage of source programs on disk files or cassette. JOIN command for appending two source programs from cassette. Standard Apple II syntax for opcodes and address modes. Labels (up to 6 characters), arithmetic expressions, comments in a liberated line format. English language error messages (not coded numbers). DOS and Apple Monitor commands directly available within the assembler. Speed and suspension control over listing and assembly. Includes printer deiver for Practical Automation printer, with instructions for modification to any other printer. (Cassette version is still available: it has fixed line format and labels up to four characters.)
Copies: Over 200 of cassette version, over 25 of disk version.
Price: $35 for disk version, $25 for cassette version (Texas residents add 5% sales tax)
Includes: 32-page reference manual, disk with assembler, Master. Create, RAWDOS, and two sample source programs.
Author: Bob Sander-Cederlof
Available from:
S-C SOFTWARE
P.O. Box 5537
Richardson, TX 75080

Name: PRO-CAL-I
System: Commodore PET
Memory: 8K
Language: Microsoft BASIC
Hardware: PET
Description: PRO-CAL-I is a reverse polish programmable scientific calculator program ideally suited to scientific and educational applications. It combines the best features of the PET with those of hand-held calculators such as the HP 97 and the TI "Programmer". It supports single key execution of more than 50 functions and implements calculations in binary, octal, decimal, and hexidecimal number systems. The program displays 10 memory registers, 5 stack registers, and a record of the 14 most current operations.
Copes: 40
Price: $26.00 for software on cassette and an operating manual.
Author: Robert M. Munoz
Available from:
APPLICATIONS RESEARCH CO.
13460 Robleda Rd.
Los Altos Hills, CA 94022

Name: FINANCIAL ANALYSIS: A Tutorial
System: APPLE II and PET
Memory: 16K
Language: Basic
Hardware: APPLE II with cassette recorder, or a PET (8K)
Description: An interactive learning cassette with chapters on Risk, Short-term and Intermediate-term Financing, Financial Statements, and Key Business Ratios. The user is then put into the position of having to use these concepts by playing the Meany Manufacturing Business Game.
Copies: Hundreds available
Price: Sugg. Retail: $16.50
Includes: Tape cassette and informative booklet
Author: Brian Beninger
Available from:
Local APPLE or PET dealers of:
SPEAKEASY SOFTWARE LTD.
P.O. Box 1220
Kemptville, Ont., KOG 1J0

Name: STAT III
System: Commodore PET
Memory: 8K
Language: BASIC
Hardware: Standard PET
Description: STAT III accepts a set of numbers and calculates the following: mean, median, mode, highest number in the data, lowest number in the data, range, variance, standard deviation, average deviation, and sample standard deviation. STAT III can display a bar graph of the users data on the CRT. In addition the user may correct errors in his inputted data before processing.
Copies: Just released
Price: $7.95
Includes: Cassette, source listing (program is self documenting)
Author: Michael J. McCann
Available from:
THE PET PAPER
P.O. Box 43
Audubon, PA 19407

Name: Apple Pi 'Life'
System: Apple II
Memory: 4K
Language: BASIC and assembly
Hardware: Apple II with 2 operable game paddles with switches.
Description: Apple Pi 'Life' allows variable grid sizes from 8X8 up to 40X40 in increments of 1. Paddle 1 is only read when the switch is depressed. Speed is controlled by paddle 0 and can be varied from 550 gpm to 2000 gpm for an 8X8 grid. For a 40X40 grid, speed can be varied from 25 gpm to 140 gpm. The speaker is toggled each time a cell is processed, except at minimum or maximum speed, to give the sounds of 'Life'. The bottom of the grid wraps around to top of grid, and vice-versa. The right of the grid wraps around to left of grid, and vice-versa. There are three tables of pre-defined objects which can be setup on the grid by number and x,y location. A description of the object table structure is given in the documentation. Keyboard controls are: P-pause until next 'P', Z-zero grid and setup objects, O-setup objects on grid, N-new colors, and E-exit program. Any two distinct colors may be used for live and dead cells.
Copies: New, just released.
Price: $12.00. Texas residents add sales tax.
Includes: Programs, object tables on cassette, documentation.
Order Info: Checks only.
Author: Harry L. Pruetz
Available from:
Microspan Software
2213A Lanier Drive
Austin, TX 78758

Name: Amateur Radio Communications Package
System: Apple II
Memory: 8K (min)
Language: Machine Language and Integer BASIC
Hardware: Apple II and user provided interface
Description: This software package allows the Apple II to communicate in any of three codes: Morse, Baudot, or ASCII, with a minimum amount of external hardware required. Some features include: Variable size text buffer and live keyboard allow preparing text for transmission while receiving or transmitting; 3 field screen display — each field scrolling separately; user defined stored messages are referenced by a keyboard and can be inserted anywhere in the text; automatic 72 character line formatting with word wrap-around; continuously variable code speeds; adaptive Morse receive and lots more! All I/O uses the on-board (game) I/O connector.
Copies sold: over 100
Price: $18.
Includes: Cassette tape and documentation with sample interface.
Author: Chris H. Galfo - WB4JMD
Available from:
C.H. Galfo
602 Orange St.
Charlottesville, VA 22901

This Catalog is a FREE feature of MICRO. Your entry must be typed, must conform to the standard format, and Applications/Utilities will be given preference over Games.

Name: TRANSACTIONAL ANALYSIS: An Introduction
System: APPLE II and PET
Memory: 16K
Language: Basic
Hardware: APPLE II with cassette recorder, or a PET (8K)
Description: An introduction to T.A. - a system for understanding human behaviour. Chapters include: You As A Person, Stroking, Transactions, Are You Listening?, the Balancing Game. This interactive learning cassette will help you gain better understanding of why you get along with some people and not with others and may give you a better understanding of yourself!
Copies: Hundreds available
Price: Sugg. Retail: $16.50
Includes: Tape cassette and informative booklet
Author: Joy Karp
Available from:
Local APPLE or PET dealers or:
SPEAKEASY SOFTWARE LTD.
P.O. Box 1220
Kemptville, Ont., KOG 1J0, Canada

Name: DOS TEXT EDITOR
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Memory: Cassetts-16K, Applesoft Rom-24K, DOS-32K
Language: Applesoft II
Description: EDIT is a program designed to facilitate changes to disk and cassette text files. The program has 24 commands to manipulate files. Included are: INSERT, DELETE, CHANGE, SEARCH, ADD, LIST, TEXT, DISPLAY, PACK, MODE, TAB, CLEAR, APPEND, SAVE, CONCAT, and STRING CHANGE. Commands that operate on blocks of data such as Range DELETE, LIST, SEARCH, and STRING replace are also provided. EDIT may also be used to create Disk files.
Copies: Just released
Price: $16.95 (Add $5 if desired on diskette)
Specify if Applesoft ROM
Includes: Program cassette or diskette, Complete documentation, and users manual.
Author: Robert Stein
Available From:
Services Unique, Inc.
2441 Rolling View Dr.
Dayton, Ohio 45431

Name: REAL-I
System: Commodore PET
Memory: 8K
Language: Microsoft BASIC
Hardware: PET
Description: REAL-I is a real estate investment analysis program which models an investment by computing the cash flow, tax advantage, inflation hedge, internal rate of return, and other quantities as they change over the years under the effects of inflation. It specializes the calculations to the tax position of the investor and helps him to judge the relative merits of various real estate investments opportunities.
Copies: Just released
Price: $29.00 for software on cassette and an operating manual.
Author: Robert M. Munoz
Available from:
APPLICATIONS RESEARCH CO.
13460 Robleda Rd.
Los Altos Hills, CA 94022

## SYM-1 6522-BASED TIMER

John Gieryic
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Andover, MN 55303

Your SYM-1 comes with a number of timers capable of a wide range of timing intervals. Unfortunately the SYM REFERENCE MANUAL does not provide information which can easily be digested by a novice. I'd like to attempt a more down to earth description of timer 1 on the **Versatile Interface Adapter 6522** for those of us who aren't hardware inclinded. This timer is capable of very accurate time delays in the range of fractions of a second. It has an interrupt associated with it plus the ability to generate evenly spaced interrupts.

### Setting Up The Interrupts

The first step in programming this timer is to place an address in the **Interrupt Request Vector [IRQ]** located at address A67E and A67F. A67E contains the low byte of the address and A67F contains the high byte. This address in the **IRQ** is the location you will be "jerked to" when the timer times down and generates an interrupt. Your code will be as follows:

| Location | Code | | |
|---|---|---|---|
| 200 | 20 86 8B | JSR ACCESS | disable memory write protect |
| 203 | A9 00 | LDA #00 | interrupt address |
| 205 | 8D 7E A6 | STA A67E | Low byte |
| 208 | A9 03 | LDA #03 | |
| 20A | 8D 7F A6 | STA A67F | High byte |

Our next step is to set two locations so the hardware can "see" the interrupt and tell us where it is coming from. These two locations are the **Interrupt Flag Register [IFR]** at location A00D and the **Interrupt Enable Register [IER]** at location A00E. The **IER** controls interrupts from 7 different sources on the **6522**. We will only be interested in bit 6. This is the one for our timer T1. We must set this bit to a logic 1. This tells the **6522** we will accept interupts from timer T1. The code follows:

| Location | Code | |
|---|---|---|
| 20D | A9 CO | LDA #CO |
| 20F | 8D OE AO | STA AOOE |

"Hey, wait a minute! Where did that 'C' come from? I thought you said we were only going to set bit 6?"

Yes, I did. We must supply the **6522** with a bit more information (no pun intended). We must tell it we are going to **SET** one of the **IER** bits. This is done by setting bit 7 to a logic 1, hence our CO. Note bits 0 thru 5 are a zero. This tells the **6522** we don't want to change the condition of any of the other bits in the **IER** when we do our store. From this you should be able to see how we **CLEAR** any one of the **IER** bits. You guessed it. Bit 7 will be a logic zero and the **IER** bit(s) to be cleared will be a logic 1.

The **Interrupt Flag Register [IFR]** tells the user which interrupt has occurred (when we get one). This information can be used by the interrupt routine to "see" which element on the **6522** gave us the interrupt. We want to initialize (clear) our flag bit for timer T1 (bit 6). I don't want to disturb any of the other bits. Note clearing a bit in the **IFR** is **not** the same as in the **IER**.

| Location | Code | |
|---|---|---|
| 212 | AD OD AO | LDA AOOD |
| 215 | 29 BF | AND #BF |
| 217 | 8D OD AO | STA AOOD |

When we do get an interrupt from any of the enabled **6522** devices (bit = 1 in the **IER**) then bit 7 in the **IFR** and the corresponding bit in the **IFR** will both be set to a logic 1. We can determine if this interrupt came from the **6522** by just looking at bit 7 of the **IFR** (ASL followed by a test of the C bit). If bit 7 is a logic zero then the interrupt came from some other place. This will save some time when we are trying to find out where this interrupt originated. You should log this bit 7 information in the back of your mind since I won't use it here.

### Setting Up The Timer

One more step before starting our timer. I'm going to set our timer to the free running mode. This means it will count down, give an interrupt and then immediately begin counting down again. I won't need to worry about instruction cycle times within any timing loops. I know I will get repeated interrupts at the exact interval requested. Setting the **Auxiliary Control Register [ACR]** bit 7 to a logic 1 establishes the free running mode.

| Location | Code | |
|---|---|---|
| 21A | A9 CO | LDA #CO |
| 21C | 8D OB AO | STA AOOB |

Now we have the four mechanical steps finished...setting up the **IRQ, IFR, IER** and **ACR**. Setting the time delay is next. The T1 timer has two latches (high and low order) and two counters (high and low order). This results in a 16 bit counter. The low order latch is loaded first. In this example I will set up for a delay of .05 seconds. This corresponds to a count of C350 (one count for each microsecond).

| Location | Code | | |
|---|---|---|---|
| 21F | A9 50 | LDA #50 | load low order latch |
| 221 | 8D 06 AO | STA A006 | |

Now we will load the high order latch with the value C3. This instruction will do more than load the high order latch. It will also write the high order latch into the high order counter as well as write the low order latch into the low order counter. This one instruction will transfer all 16 bits from the latches to the counter at the same instant. Without this hardware assist we would be unable to load the counter accurately since the counter begins to count down immediately after being loaded.

| Location | Code | | |
|---|---|---|---|
| 224 | A9 C3 | LDA #C3 | load high order latch |
| 226 | 8D 05 AO | STA A005 | |

The timer is now running and will generate an interrupt .05 seconds (C350) later. This corresponds to 50,000 clock cycles. If you were programming a clock your remaining code at location 229 would now initialize your hours, minutes and seconds counters, initialize the display buffer and then go into a tight loop calling SCAND in order to illuminate the LED's.

### Servicing The Interrupt

Our interrupt routine at location 300 is now executed when we receive the interrupt. The first thing we must do is SAVE the processor status and registers. This is done so we can restore these items when we are finished with our interrupt processing and jump back into SCAND from where we were "jerked out."

| Location | Code | | |
|---|---|---|---|
| 300 | 08 | PHP | save processor status on stack |
| 301 | 48 | PHA | save accumulator on stack |
| 302 | 8A | TXA | transfer X to A |
| 303 | 48 | PHA | save X register on stack |
| 304 | 98 | TYA | transfer Y to A |
| 305 | 48 | PHA | save Y register on stack |

If you were programming a clock you would now increment a counter. If the counter equalled twenty then reset it and increment the time in the display buffer by one second.

Now the interrupt is "serviced." In order to clear the way for the next interrupt, the T1 interrupt flag must be reset otherwise the next interrupt will be blocked. This clearing can be done in either of two ways. Method 1 will write into the high order latch. This write uses a different address for the store instruction than the write used to initialize the timer counter. In doing this the T1 interrupt flag will be reset but it will not disturb the current value in the counter. Remember this is a free running counter in our example and automatically resets itself when the interrupt occurred. By this point in time it has already counted down from its original value of C350 toward zero (and the next interrupt). Method 2 will read the low order counter. Either method will reset the T1 interrupt flag.

Method 1

**Code**

```
A9 C3       LDA #C3
8D 07 AO    STA A007
```

Method 2

**Code**

```
AD 04 AO    LDA A004
```

Now the processor status and registers can be restored and a return executed to the location in SCAND at which the interrupt occurred. Remember you **must** restore the registers in the exact reverse order used at the entrance to the interrupt routine. This is a major point.

**Code**

```
68    PLA    pull accumulator from stack
A8    TAY        transfer to Y index
68    PLA    pull accumulator from stack
AA    TAX        transfer to X index
68    PLA    pull accumulator from stack
28    PLP    pull processor status from stack
40    RTI    Return from Interrupt
```

That's the end of the lesson for today. In a future article I will use the information presented here to develop an operating system for your SYM-1.


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## THE TVT-6: A USER'S REPORT

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As a computer hobbyist who wanted a video interface for his KIM-1, it took me a long time to decide which video board of the many available to choose. The main factor which influenced my decision was the prohibitive cost of most video interfaces, typically around $150 to $200. Being on a college student's budget, these prices were way out of my range. I was beginning to lose all hope when, at the PCC '77 in Atlantic City, I discovered the TVT-6, a video board for the KIM-1, for only $35!

After mulling it over for a few days ($35 is still a lot of money!) and weighing the board's strengths and weaknesses, I decided to order a TVT-6 kit from PAIA Electronics. I received my kit in about 2 weeks and built it in one night. The construction was fairly easy, although it may have been slightly more difficult for someone with no construction experience. This was due mainly to the fact that the instructions consisted of a reprinted construction article from a magazine. The board worked the first time I hooked it up except for a capacitor which I found out later, after a call to PAIA, had to be a slightly lower value. The effect of the bad capacitor was to widen the characters on the screen to the point that they interfered with each other. I must mention that the Technical Services Dept. at PAIA was very helpful and sent the correct value capacitor to me within a few days.

I must say that Don Lancaster's TVT-6 design is truly amazing but, due to the fact that it uses the 6502 for its timing, it has a few drawbacks. In the remainder of this article I will try to describe the TVT-6's strengths as well as its weaknesses as I see them, having used this video board for over a year.

The main weakness one encounters using the TVT-6 is the fact that the display disappears whenever the display program is not running. When using an interrupt, such as an ASCII keyboard, the problem is not as apparent as when implementing another routine which is relatively long in execution time. Also, if the display program is repeatedly called as a subroutine from another program, a noticeable jitter in the display results, which can be very annoying. A good example of this would be trying to play a 'pong' type game on the screen.

Another minor annoyance is that the display program must be loaded from tape every time the computer is powered up before the display will work. Also, for KIM owners without expansion memory, pages 2 and 3 of the KIM RAM cannot be used for program space without garbage showing on the screen.

One drawback is the fact that memory locations $8000 through $DFFF are used by the TVT-6 scan PROM and cannot be used for expansion memory.

Most of the above weaknesses may seem pretty important at first, but in fact they are not, and there are ways of getting around them. Since the screen flickers when called repeatedly by another program, such as a disassembler listing, I simply have the disassembler fill the screen before calling the display routine, thus displaying whole pages at a time.

Though locations $8000 through $DFFF cannot be used for expansion memory, this still leaves space for 36K of expansion, which I feel is more than enough for the average KIM owner.

Now that I have outlined the weaknesses of the TVT-6 and some ways of getting around them, I will describe its strengths, which, I feel, far outweigh the disadvantages.

The most outstanding advantage of the TVT-6 is its $35 price tag. As far as I know, no other video board even comes close to that price range. Add to that its lower power consumption, (I have used the KIM +5 volt supply to power the KIM and the TVT-6), its small size, variable display size, and software cursor control, and you have what I believe is one of the biggest hardware buys around. Above all, I think that the TVT-6 display is one of the cleanest and sharpest that I have seen!

In conclusion, I must admit that if you can afford to lay out $200 for a video interface, then one of the more expensive boards may be what you need. However, if you're looking for a video board that works great and won't empty your wallet, the TVT-6 is definitely for you!

Editor's Note: One important disadvantage which is not mentioned above is that of using the TVT-6 with existing software. If you are planning to write all of your own code, this is no problem. But if, more typically, you are going to use software which was written by others without a TVT-6, you may encounter serious problems. Some packages may be very difficult to interface to the TVT-6; others may be impossible due to timing considerations. The TVT-6 is a remarkable illustration of what can be done with a 6502 and may be a total solution for some applications. But, it may not be adequate in other applications. For a lot more information on the TVT-6, you should consult (buy?) **The Cheap Video Cookbook** by Don Lancaster, 1978. This book is published by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis, IN 46288 and retails at your local computer shop for $5.95. This is a good tutorial on videos whether or not you intend to buy/build the TVT-6, but is not for the complete novice.

For a catalog/price list on their line of cheap video pc boards, kits, etc., contact:
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# THE ULTIMATE PET RENUMBER

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The Bit Stop
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Mobile, Alabama 36601

This article can be of help to the BASIC programmer in providing a fast, fool-proof renumbering system, but it also includes details on how to use the PET BASIC interpreter's own machine-language routines to do some useful chores.

Renumbering programs written in BASIC, such as Jim Butterfield's (see MICRO Dec 78 - Jan 79) are very slow in renumbering long programs, and because BASIC is cumbersome in performing such routine chores, the machine-language approach has some major advantages. This routine will renumber a 300-line program in around 20 seconds, as compared to more than 300 seconds for Jim's BASIC version. Further, Jim is forced to duck the issue of providing space for extra-digit line numbers, whereas by calling BASIC's line insertion routine, this program provides enough space for five digits for every GOTO, GOSUB, etc.

The entire program for renumbering is given in hexadecimal in listing 1. More later about how to enter it into your machine. With your BASIC program and the renumber routine in RAM, press SYS8181 (by coincidence, the name of the program) and you will either get a message of reassurance that all has gone well, or will get an error message, such as "line too long". In no case will the program bomb, because this is a two-pass program; during the first pass, nothing is done to the Basic text, other than making sure there is enough space for five-digit line numbers. If any problem exists, the BASIC text is unchanged.

## DEVELOPING THE PROGRAM

Commodore made it a formidable task to decipher the code of BASIC sufficiently to be able to make patches for a short renumber system. The first obstacle is that the PEEK statement is disabled for the area of memory where BASIC resides. But, by sleight-of-hand, a little PUNCHing and POKEing and addition of a simple output port on PET's memory-expansion connector, the PET disgorged the contents of its ROMs into my homebrew machine and onto a disk; now, with the capability of having the programs in RAM, where breaks could be inserted for diagnosis, the job became a little easier.

Programming a renumber routine is made tedious by the fact that, in the BASIC text, the line numbers following the GOTO tokens are coded in ASCII, whereas the line numbers at the beginning of a line of text are coded as two-byte hex numbers. Fortunately, the BASIC interpreter has rountines built in to do these conversions back and forth between ASCII and hex. The locations of these and other routines called by this program are given in TABLE 1. Another problem encountered was locating some page zero registers, essential to 6502 programming, which are not altered by the BASIC itself. In some cases, I use space in the line buffer at 000A-0059, but this cannot be done in the section of the Program which uses the line buffer for its original purpose, i.e., inserting a line in its proper place in the BASIC text.

This program uses very little RAM, since no tables are created.

## PROGRAM OPERATION

The program first sets or clears a flag, depending upon entry point (DCM 8181 or 8184), since entry point determines whether the renumber job is standard or custom. It then checks to see if sufficient memory exists to allow for insertion of spaces for as many as five digits for GOTO line numbers. An error message (see TABLE 2) is generated if there is less than one page available for this enlargement of the program. Then, each line of text is moved into the line buffer, and if a GOTO, GOSUB, or THEN (followed by a number) is present, spaces are inserted and the expanded line is inserted by BASIC's own line-insertion routine into the text area, just as though you retyped the line on the keyboard. Any lines too long for this expansion produce an error message before any harm is done to the program. BASIC's own error routine is called to print these messages! The "TOO LONG" message is a shortened version of "STRING TOO LONG" used by BASIC.

In the text, all statements are compressed into single-byte tokens, which I have listed for your reference in TABLE 3. For example, GOSUB is hex 8D, THEN is A7, etc. This program searches out all the 89, 8D and A7 tokens. Getting the proper ASCII numbers after these tokens requires conversion of the ASCII to hexadecimal and searching for a matching line number in the text area. If no match is found, the guy evidently had a GOTO pointing to a non-existent line number, so we flag this in the text by an opening parenthesis, such as:

```
GOTO(
GOSUB( :X=X+1
IF A=B THEN(
ON X GOTO 1234,(     ,5678,9987
```

When the progra is listed or run, the need for correction is obvious. While we are searching for a matching line number, we keep track of the new line number which corresponds to the current position in the text, so that when the match is found, the new line number can be converted to ASCII and placed directly into the text.

The actual resequencing process which follows is an anticlimax, because it requires so little coding (1E16-1E3E). When the entire renumbering job is done, we jump back to BASIC's warm start location.

## USING THE PROGRAM

If you would like to renumber your program with the standard starting line number 100 and increment by 10, simply type SYS8181, which directs the program to hex address 1FF5. If you would like to choose a different starting line number or increment, POKE the desired values at the addresses shown in LISTING 2, and type SYS8184 to enter the program at 1FF8. If your BASIC program is long, it may take 3-4 seconds to complete the renumbering job. After renumbering, running the program will generally write over the renumber code, since it occupies the same space as some BASIC variables. The only precaution to be taken in renumbering is to avoid line numbers which exceed PET's limit of 63999.

| ROUTINE ENTRY POINT (HEX) | FUNCTION AND IMPLEMENTATION |
|---|---|
| C359 | Print an error message from the message table. Enter with X containing the location of the message relative to C190. Message terminator is ASCII having bit 7 on. |
| 1F00 | A duplicate of the original BASIC line insertion routine located at C3B4, except for the exit jump. Enter with the line assembled in the line buffer 000A-0059 with 00 as line terminator. Also, the character count must be in 005C, and the line number (hex) at 0008/9. |
| CCA4 | Evaluate an expression whose beginning address is in 00C9/CA. We use this sub to convert from ASCII to binary, with the result appearing in the floating accumulator 00B0↑. |
| DB1B | Convert fixed number in 00B1/2 to floating number. Enter with X=90 and carry set. |
| D6D0 | Convert binary value, such as line number, in floating accumulator to two-byte fixed number and place in 0008/9. |
| DCAF | Convert floating number at 00B0↑ to ASCII and place in a string starting at 0101, preceded by a space or minus sign at 0100 and terminated by 00. |
| C38B | BASIC warm start. Prints READY. |
| CA27 | Print message. Enter with ADH in Y, ADL in A. Message is ASCII string enough with 00. |
| DC9F | Print the decimal integer whose hex value is in microprocessor registers A and X, for example, a line number. |

TABLE 1 - BASIC ROUTINES USED

| MESSAGE | INTERPRETATION |
|---|---|
| CHECK FOR GOTO( ETC | Successful renumbering. |
| 120<br>? TOO LONG ERROR | Line 120 is too long to renumber. Break into two or more lines, and renumber again. |
| ? OUT OF MEMORY ERROR | Program too long to renumber. |
| ? SYNTAX ERROR | Attempt to RUN program with GOTO( remaining in program, or attempt to renumber with one of these in program text. |
| GOTO(<br>GOSUB(<br>ON X GOTO(<br>IF A=B THEN( | The opening parenthesis in the text represents attempt to reference a non-existent line number. |

Note: Lines of the following form are likely to cause a TOO LONG error:

100 ON X GOSUB 1,2,3,4,5,6,7,8,9,10,11,12

TABLE 2 - MESSAGES

```
                RENUMB ORG   $1D00
                   DON RINDSBERG
                   (C) 1978 N.A.I.L.

                      (& SIGN MEANS PLUS)

                 EXTERNAL ROUTINES

INSERT .      $1F00  INSERT A LINE INTO TEXT
MESSG  .      $1FCA  DONE MESSAGE

                 TEMPORARIES

BUFF   .      $0008  LINE BUFFER LOCATION
POINT  .      $0019  TEMP LINE BUFF POINTER
POINTX .      $001A  TEMP POINTER
LINCNT .      $005C  NO. CHAR. IN LINE
PTRSO  .      $007A  ORIGINAL POINTERS
PTRS   .      $006A  WORKING POINTERS
FLAG   .      $0069  FLAG THE GOTOS
BUFPTR .      $006E  LINE BUFF POINTER PAGE ZERO
COUNT  .      $006F  COUNTER
STARTC .      $00DB  CUSTOM STARTING LINE NO.
INTC   .      $00DD  CUSTOM INTERVAL
CUSTOM .      $00DE  FLAG CUSTOM JOB

                 BASIC PARAMETERS

FACC   .      $00B0  BASIC FLOATING ACCUM
BASICP .      $00C9  BASIC POINTER
BERROR .      $C359  BASIC ERROR ROUTINE
WARM   .      $C38B  BASIC WARM START
PRINT  .      $CA27  BASIC PRINT ROUTINE
EVAL   .      $CCA4  EXPRESSION EVALUATOR
FIX    .      $D6D0  CONVERT TO FIXED DP
FLOAT  .      $DB1B  CONVERT FIXED NMBR TO FLOAT
PNUMBR .      $DC9F  BASIC PRINT NUMBER
ASCII  .      $DCAF  CONVERT NMBR TO ASCII AT $0100

                   MAINLINE

1D00 A5 7D     START  LDA   PTRSO  &03 GET END TEXT ADH
1D02 C9 1B            CMPIM $1B   ENOUGH ROOM TO EXPAND?
1D04 90 05            BCC   SPACE
1D06 A2 52     BOMB   LDXIM $52   OUT OF MEMORY
1D08 4C FC 1E         JMP   ERROR
1D0B 20 BD 1E  SPACE  JSR   COPY   MAKE CC TEXT POINTERS
1D0E 20 3F 1E  NEXT   JSR   DNTST  ARE WE DONE THIS SECTION?
1D11 F0 2B            BEQ   RENUM
1D13 A2 08            LDXIM $08    LINE BUFFER START
```

```
1D15 A0 02          LDYIM $02    POINT TO LINE NMBR IN TEXT
1D17 B1 6A  GETBYT  LDAIY PTRS   GET BYTE FROM TEXT
1D19 95 00          STAZX $00    STORE IN LINE BUFFER
1D1B C0 04          CPYIM $04    ZERO HERE NOT TERMINATOR
1D1D 90 04          BCC   SKIPA
1D1F C9 00          CMPIM $00
1D21 F0 04          BEQ   TERM   GOT THE TERMINATOR
1D23 C8     SKIPA   INY
1D24 E8             INX
1D25 D0 F0          BNE   GETBYT FORCED BRANCH
1D27 20 47 1E TERM  JSR   EDIT   EDIT ONE LINE
1D2A A5 69          LDAZ  FLAG
1D2C D0 0A          BNE   SKIPB  SKIP IF NO GOS FLAGGED
1D2E 38             SEC
1D2F A5 6E          LDA   BUFPTR
1D31 E9 05          SBCIM $05    CORRECT BYTE COUNT
1D33 85 5C          STA   LINCNT NEED CHAR COUNT
1D35 4C 00 1F       JMP   INSERT BUT RETURN TO NEXT LINE
1D38 20 C7 1E SKIPB JSR   UPDATE POINT TO NEXT LINE
1D3B 4C 0E 1D       JMP   NEXT


1D3E 20 BD 1E RENUM JSR   COPY   THE POINTERS
1D41 20 3F 1E NEXTR JSR   DNTST  ARE WE DONE THIS PORTION?
1D44 D0 03          BNE   NOTDON
1D46 4C 16 1E       JMP   RESEQ
1D49 20 AE 1F NOTDON JSR  STRTLN GET STARTING LINE NMBR
1D4C A0 03    SCAN  LDYIM $03    POINT TO TEXT-1
1D4E C8       SCANA INY
1D4F B1 6A    SCANX LDAIY PTRS   GET A BYTE
1D51 D0 06          BNE   GOTEST BRANCH IF NOT TERMINATOR
1D53 20 C7 1E       JSR   UPDATE GO TO NEXT LINE
1D56 4C 41 1D       JMP   NEXTR
1D59 C9 89    GOTEST CMPIM $89   GOT A GOTO?
1D5B F0 15          BEQ   GOTO
1D5D C9 8D          CMPIM $8D    GOT A GOSUB?
1D5F F0 11          BEQ   GOTO
1D61 C9 A7          CMPIM $A7    GOT A THEN?
1D63 D0 E9          BNE   SCANA
1D65 C8       THEN  INY          POINT TO NEXT
1D66 B1 6A          LDAIY PTRS
1D68 C9 20          CMPIM $20    IGNORE SPACES
1D6A F0 F9          BEQ   THEN
1D6C 20 E5 1E       JSR   TSTDGT TEST FOR NUMBER
1D6F B0 E8          BCS   GOTEST
1D71 88             DEY
1D72 C8       GOTO  INY
1D73 84 19          STY   POINT  SAVE A MOMENT
1D75 98             TYA
1D76 18             CLC
1D77 65 6A          ADC   PTRS   POINT TO ASCII NMBRS
1D79 85 C9          STA   BASICP
1D7B 20 ED 1F       JSR   PATCH  BUG FIX
1D7E EA             NOP
1D7F 20 A4 CC       JSR   EVAL   CALL BASIC EVALUATOR
1D82 20 D0 D6       JSR   FIX    AND BASIC FIX ROUTINE
```

```
1D85 A5 7A      SEARCH LDA   PTRSO  SETUP SEARCH POINTERS
1D87 85 1A             STA   POINTX
1D89 A5 7B             LDA   PTRSO  &01
1D8B 85 1B             STA   POINTX &01
1D8D A0 00      SRCHLP LDYIM $00
1D8F B1 1A             LDAIY POINTX GET NEXT BYTE
1D91 C8                INY
1D92 11 1A             ORAIY POINTX TEST FOR TWO ZERO BYTES
1D94 D0 10             BNE   NOTEND ZEROES MARK EOT
1D96 A9 20             LDAIM $20    GET A SPACE
1D98 8D 00 01          STA   $0100  ASCII WORKSPACE
1D9B A9 28             LDAIM $28    GET OPEN PAREN
1D9D 8D 01 01          STA   $0101
1DA0 88                DEY
1DA1 8C 02 01          STY   $0102  TERMINATE WITH ZERO
1DA4 F0 20             BEQ   MVASC  FORCED BRANCH
1DA6 A0 02      NOTEND LDYIM $02
1DA8 B1 1A             LDAIY POINTX GET LINE NO. LOW
1DAA C5 08             CMP   BUFF   MATCH?
1DAC D0 55             BNE   NOMAT
1DAE C8                INY
1DAF B1 1A             LDAIY POINTX GET LINE NO. HIGH
1DB1 C5 09             CMP   BUFF   &01
1DB3 D0 4E             BNE   NOMAT
1DB5 A6 10      MATCH  LDX   BUFF   &08 GET CURRENT LINE NMBR
1DB7 86 B2             STX   FACC   &02
1DB9 A5 11             LDA   BUFF   &09 SECOND BYTE
1DBB 85 B1             STA   FACC   &01
1DBD A2 90             LDXIM $90    SETUP FOR FLOAT
1DBF 38                SEC
1DC0 20 1B DB          JSR   FLOAT
1DC3 20 AF DC          JSR   ASCII  TO $0101 PLUS
1DC6 A2 FB      MVASC  LDXIM $FB    MINUS 5
1DC8 A4 19             LDY   POINT
1DCA BD 06 00   LOOPA  LDAAX $0006
1DCD F0 08             BEQ   BLANKS TERMINATOR ZERO
1DCF 91 6A             STAIY PTRS
1DD1 C8                INY
1DD2 E8                INX
1DD3 D0 F5             BNE   LOOPA
1DD5 F0 0C             BEQ   COMMA
1DD7 A9 20      BLANKS LDAIM $20    GET SPACE
1DD9 91 6A             STAIY PTRS   STORE IT
1DDB C8                INY
1DDC E8                INX
1DDD D0 F8             BNE   BLANKS
1DDF 88                DEY
1DE0 D0 01             BNE   COMMA
1DE2 C8         COMMX  INY
1DE3 B1 6A      COMMA  LDAIY PTRS   GET NEXT BYTE
1DE5 20 E5 1E          JSR   TSTDGT TEST FOR NUMBER
1DE8 B0 06             BCS   NOTNUM
1DEA A9 20             LDAIM $20    SPACE
1DEC 91 6A             STAIY PTRS   STORE IT
1DEE D0 F2             BNE   COMMX  FORCED
1DF0 C9 20      NOTNUM CMPIM $20    SPACE?
```

```
1DF2 F0 EE            BEQ   COMMX
1DF4 C9 2C            CMPIM $2C     COMMA?
1DF6 08               PHP           DEFER TEST
1DF7 20 AE 1F         JSR   STRTLN GET STARTING LINE NMBR
1DFA 28               PLP           NOW TEST
1DFB D0 03            BNE   JSCANX NOT COMMA
1DFD 4C 72 1D         JMP   GOTO    GOT A COMMA
1E00 4C 4F 1D JSCANX  JMP   SCANX
1E03 20 EE 1E NOMAT   JSR   INCLIN INCR NEW LINE NMBR
1E06 A0 00            LDYIM $00
1E08 B1 1A            LDAIY POINTX GET NEXT LINE ADDRESS
1E0A 48               PHA
1E0B C8               INY
1E0C B1 1A            LDAIY POINTX
1E0E 85 1B            STA   POINTX &01
1E10 68               PLA
1E11 85 1A            STA   POINTX
1E13 4C 8D 1D         JMP   SRCHLP BACK TO SEARCH AGAIN


1E16 20 AE 1F RESEQ   JSR   STRTLN SETUP STARTING LINE
1E19 20 BD 1E         JSR   COPY    COPY THE POINTERS
1E1C 20 3F 1E LOOPR   JSR   DNTST  DONE?
1E1F F0 13            BEQ   WINDUP
1E21 A0 02            LDYIM $02     POINT TO LINE NMBR
1E23 A5 10            LDA   BUFF    &08 GET NEW ONE
1E25 91 6A            STAIY PTRS    STORE IT
1E27 C8               INY
1E28 A5 11            LDA   BUFF    &09
1E2A 91 6A            STAIY PTRS
1E2C 20 C7 1E         JSR   UPDATE ADVANCE TO NEXT LINE
1E2F 20 EE 1E         JSR   INCLIN INCREMENT LINE NMBR
1E32 90 E8            BCC   LOOPR  FORCED
1E34 A0 1F      WINDUP LDYIM MESSG  /100
1E36 A9 CA            LDAIM MESSG
1E38 20 27 CA         JSR   PRINT   END MESSAGE
1E3B 58               CLI           ALLOW KEYPRESSES
1E3C 4C 8B C3         JMP   WARM    BACK TO BASIC


1E3F A0 00      DNTST LDYIM $00
1E41 B1 6A            LDAIY PTRS    GET NEXT BYTE
1E43 C8               INY           ADVANCE TO NEXT
1E44 11 6A            ORAIY PTRS    OR WITH LAST TO FIND 0000
1E46 60               RTS


1E47 A2 09      EDIT  LDXIM BUFF    &01
1E49 86 6E            STX   BUFPTR
1E4B 86 69            STX   FLAG    SET FLAG
1E4D E6 6E      EDITX INC   BUFPTR
1E4F A6 6E            LDX   BUFPTR
1E51 B5 00            LDAZX $00
1E53 F0 71            BEQ   RTS
1E55 C9 89      EDITY CMPIM $89     GOTO?
1E57 F0 19            BEQ   SPACES
```

```
1E59 C9 8D            CMPIM $8D     GOSUB?
1E5B F0 15            BEQ   SPACES
1E5D C9 A7            CMPIM $A7     THEN?
1E5F D0 EC            BNE   EDITX  BACK FOR MORE
1E61 E6 6E     THENN  INC   BUFPTR
1E63 A6 6E            LDX   BUFPTR
1E65 B5 00            LDAZX $00     BYTE AFTER THEN
1E67 C9 20            CMPIM $20     IGNORE SPACES
1E69 F0 F6            BEQ   THENN
1E6B 20 E5 1E         JSR   TSTDGT IS IT NUMBER?
1E6E B0 E5            BCS   EDITY  IF NOT, GO BACK
1E70 C6 6E            DEC   BUFPTR
1E72 A2 09     SPACES LDXIM BUFF   &01 TEXT-1
1E74 E8        SPACEX INX
1E75 B5 00            LDAZX $00     LOOK FOR TERMINATOR
1E77 D0 FB            BNE   SPACEX
1E79 E0 54            CPXIM $54     LINE TOO LONG?
1E7B 90 0C            BCC   OKAY
1E7D A5 09            LDA   BUFF    &01
1E7F A6 08            LDX   BUFF    GET BAD LINE NMBR
1E81 20 9F DC         JSR   PNUMBR PRINT IT
1E84 A2 BB            LDXIM $BB     TOO LONG MESSG
1E86 4C FC 1E         JMP   ERROR
1E89 A2 06     OKAY   LDXIM $06     DIGITS PLUS ONE
1E8B 86 6F            STX   COUNT
1E8D E6 6E     LOOP   INC   BUFPTR
1E8F C6 6F            DEC   COUNT
1E91 F0 12            BEQ   COMMAS
1E93 A6 6E            LDX   BUFPTR
1E95 B5 00            LDAZX $00
1E97 C9 20            CMPIM $20     TEST FOR SPACES
1E99 F0 F2            BEQ   LOOP
1E9B 20 E5 1E         JSR   TSTDGT TEST FOR NUMBER
1E9E 90 ED            BCC   LOOP
1EA0 20 D5 1E         JSR   UPONE  MAKE ROOM FOR ONE DIGIT
1EA3 D0 E8            BNE   LOOP   FORCED BRANCH
1EA5 A0 00     COMMAS LDYIM $00
1EA7 84 69            STY   FLAG    WE WERE HERE
1EA9 A6 6E     FINDT  LDX   BUFPTR
1EAB B5 00            LDAZX $00     FIND TERMINATOR
1EAD F0 17            BEQ   RTS
1EAF C9 20            CMPIM $20     SPACE?
1EB1 D0 04            BNE   TEST
1EB3 E6 6E            INC   BUFPTR
1EB5 D0 F2            BNE   FINDT   FORCED
1EB7 C9 2C     TEST   CMPIM $2C     COMMA?
1EB9 F0 B7            BEQ   SPACES
1EBB D0 90            BNE   EDITX


1EBD A2 04     COPY   LDXIM $04     COPY 4 BYTES
1EBF B5 79     LP     LDAZX $79
1EC1 95 69            STAZX $69     COPY POINTERS
1EC3 CA               DEX
1EC4 D0 F9            BNE   LP
1EC6 60        RTS    RTS
```

```
1EC7 A0 00     UPDATE LDYIM $00
1EC9 B1 6A            LDAIY PTRS    GET LINK ADL
1ECB 48               PHA           HOLD ON STACK
1ECC C8               INY
1ECD B1 6A            LDAIY PTRS    GET LINK ADH
1ECF 85 6B            STA   PTRS    &01 STORE LINK ADH
1ED1 68               PLA
1ED2 85 6A            STA   PTRS    STORE LINK ADL
1ED4 60               RTS


1ED5 A2 59     UPONE  LDXIM BUFF    &51 END BUFFER
1ED7 CA        LOOPU  DEX
1ED8 B5 00            LDAZX $00     GET A BYTE
1EDA 95 01            STAZX $01     MOVE UP ONE
1EDC E4 6E            CPX   BUFPTR
1EDE D0 F7            BNE   LOOPU
1EE0 A9 20            LDAIM $20     INSERT SPACE
1EE2 95 00            STAZX $00
1EE4 60               RTS


1EE5 C9 30     TSTDGT CMPIM '0
1EE7 90 03            BCC   SET
1EE9 C9 3A            CMPIM ':
1EEB 60               RTS           WITH CARRY CLEAR
1EEC 38        SET    SEC           CARRY SET IF NON-NMBR
1EED 60               RTS


1EEE 18        INCLIN CLC
1EEF A5 10            LDA   BUFF    &08
1EF1 65 12            ADC   BUFF    &0A
1EF3 85 10            STA   BUFF    &08
1EF5 A5 11            LDA   BUFF    &09
1EF7 69 00            ADCIM $00     ADD INTERVAL
1EF9 85 11            STA   BUFF    &09  TO CURRENT LINE
1EFB 60               RTS


1EFC 58        ERROR  CLI           ALLOW KEYPRESS
1EFD 4C 59 C3         JMP   BERROR  BASIC ERROR PROCESSOR


1FAE                  ORG   $1FAE


1FAE A9 64     STRTLN LDAIM $64     DEFAULT 100
1FB0 85 10            STA   BUFF    &08
1FB2 A9 00            LDAIM $00     HIGH ORDER
1FB4 85 11            STA   BUFF    &09
1FB6 A2 0A            LDXIM $0A     INTERVAL 10
1FB8 A5 DE            LDA   CUSTOM  TEST FOR CUSTOM
```

```
1FBA 10 0A            BPL   SKIPL
1FBC A6 DD            LDX   INTC    CUSTOM INTERVAL
1FBE A5 DB            LDA   STARTC  CUSTOM START
1FC0 85 10            STA   BUFF    &08
1FC2 A5 DC            LDA   STARTC  &01
1FC4 85 11            STA   BUFF    &09
1FC6 86 12      SKIPL STX   BUFF    &0A
1FC8 60               RTS
1FC9 EA               NOP

                FINAL MESSAGE $1FCA THROUGH $1FEC
                "CHECK FOR GOTO( ETC"

1FED            PATCH ORG   $1FED

1FED A5 6B            LDA   PTRS    &01
1FEF 69 00            ADCIM $00
1FF1 85 CA            STA   BASICP  &01
1FF3 60               RTS
1FF4 EA               NOP

1FF5 18         ENTRY CLC           CLEAR FOR STANDARD
1FF6 90 01            BCC   ALL
1FF8 38         ENTRYA SEC          SET FOR CUSTOM
1FF9 78         ALL   SEI           DISABLE KEYS
1FFA 66 DE            RORZ  CUSTOM  FLAG IN BIT 7
1FFC 4C 00 1D         JMP   START
```


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```
                INSERT ORG   $1F00
                  DUPLICATE  OF BASIC INSERT ROUTINE
                  EXCEPT FOR EXIT JUMP

1F00 20 22 C5           JSR   $C522
1F03 90 44              BCC   INSC
1F05 A0 01              LDYIM $01
1F07 B1 AE              LDAIY $AE
1F09 85 72              STAZ  $72
1F0B A5 7C              LDAZ  $7C
1F0D 85 71              STAZ  $71
1F0F A5 AF              LDAZ  $AF
1F11 85 74              STAZ  $74
1F13 A5 AE              LDAZ  $AE
1F15 C8                 INY
1F16 F1 AE              SBCIY $AE
1F18 18                 CLC
1F19 65 7C              ADCZ  $7C
1F1B 85 7C              STAZ  $7C
1F1D 85 73              STAZ  $73
1F1F A5 7D              LDAZ  $7D
1F21 69 FF              ADCIM $FF
1F23 85 7D              STAZ  $7D
1F25 E5 AF              SBCZ  $AF
1F27 AA                 TAX
1F28 38                 SEC
1F29 A5 AE              LDAZ  $AE
1F2B E5 7C              SBCZ  $7C
1F2D A8                 TAY
1F2E B0 03              BCS   INSA
1F30 E8                 INX
1F31 C6 74              DECZ  $74
1F33 18         INSA    CLC
1F34 65 71              ADCZ  $71
1F36 90 03              BCC   INSB
1F38 C6 72              DECZ  $72
1F3A 18                 CLC
1F3B B1 71      INSB    LDAIY $71
1F3D 91 73              STAIY $73
1F3F C8                 INY
1F40 D0 F9              BNE   INSB
1F42 E6 72              INCZ  $72
1F44 E6 74              INCZ  $74
1F46 CA                 DEX
1F47 D0 F2              BNE   INSB
1F49 A9 0A      INSC    LDAIM $0A
1F4B F0 17              BEQ   INSD
1F4D A5 86              LDAZ  $86
1F4F A4 87              LDYZ  $87
1F51 85 82              STAZ  $82
1F53 84 83              STYZ  $83
1F55 A5 7C              LDAZ  $7C
1F57 85 A9              STAZ  $A9
1F59 65 5C              ADCZ  $5C
1F5B 85 A7              STAZ  $A7
1F5D A4 7D              LDYZ  $7D
1F5F 84 AA              STYZ  $AA
1F61 90 01              BCC   INSD
1F63 C8                 INY
1F64 84 A8      INSD    STYZ  $A8
1F66 20 DA C2           JSR   $C2DA
1F69 A5 80              LDAZ  $80
1F6B A4 81              LDYZ  $81
1F6D 85 7C              STAZ  $7C
1F6F 84 7D              STYZ  $7D
1F71 A4 5C              LDYZ  $5C
1F73 88                 DEY
1F74 B9 06 00   INSE    LDAAY $0006
1F77 91 AE              STAIY $AE
1F79 88                 DEY
1F7A 10 F8              BPL   INSE
1F7C 20 67 C5   INSF    JSR   $C567
1F7F A5 7A              LDAZ  $7A
1F81 A4 7B              LDYZ  $7B
1F83 85 71              STAZ  $71
1F85 84 72              STYZ  $72
1F87 18                 CLC
1F88 A0 01      INSG    LDYIM $01
1F8A B1 71              LDAIY $71
1F8C D0 03              BNE   INSH
1F8E 4C 38 1D           JMP   $1D38
1F91 A0 04      INSH    LDYIM $04
1F93 C8         INSI    INY
1F94 B1 71              LDAIY $71
1F96 D0 FB              BNE   INSI
1F98 C8                 INY
1F99 98                 TYA
1F9A 65 71              ADCZ  $71
1F9C AA                 TAX
1F9D A0 00              LDYIM $00
1F9F 91 71              STAIY $71
1FA1 A5 72              LDAZ  $72
1FA3 69 00              ADCIM $00
1FA5 C8                 INY
1FA6 91 71              STAIY $71
1FA8 86 71              STXZ  $71
1FAA 85 72              STAZ  $72
1FAC 90 DA              BCC   INSG
```

| LOCATION | | |
|---|---|---|
| HEX | DECIMAL | VALUE TO BE POKED |
| 00DB | 219 | Low order starting line number (wieght 1) |
| 00DC | 220 | High order starting line number (weight 256) |
| 00DD | 221 | Increment desired (1-255) |

Example: POKE 219,232
POKE 220,3
POKE 221,50

This will give a starting line number of 3 x 256 † 232 = 1000, and following lines will be incremented by 50.

LISTING 2 - NON-STANDARD LINE RENUMBER

| STATEMENT | TOKEN | STATEMENT | TOKEN |
|---|---|---|---|
| END | 80 | FN | A5 |
| FOR | 81 | SPC( | A6 |
| NEXT | 82 | THEN | A7 |
| DATA | 83 | NOT | A8 |
| INPUT# | 84 | STEP | A9 |
| INPUT | 85 | + | AA |
| DIM | 86 | - | AB |
| READ | 87 | * | AC |
| LET | 88 | / | AD |
| GOTO | 89 | ↑ | AE |
| RUN | 8A | AND | AF |
| IF | 8B | OR | B0 |
| RESTORE | 8C | > | B1 |
| GOSUB | 8D | = | B2 |
| RETURN | 8E | < | B3 |
| REM | 8F | SGN | B4 |
| STOP | 90 | INT | B5 |
| ON | 91 | ABS | B6 |
| WAIT | 92 | USR | B7 |
| LOAD | 93 | FRE | B8 |
| SAVE | 94 | POS | B9 |
| VERIFY | 95 | SQR | BA |
| DEF | 96 | RND | BB |
| POKE | 97 | LOG | BC |
| PRINT# | 98 | EXP | BD |
| PRINT | 99 | COS | BE |
| CONT | 9A | SIN | BF |
| LIST | 9B | TAN | C0 |
| CLR | 9C | ATN | C1 |
| CMD | 9D | PEEK | C2 |
| SYS | 9E | LEN | C3 |
| OPEN | 9F | STR$ | C4 |
| CLOSE | A0 | VAL | C5 |
| GET | A1 | ASC | C6 |
| NEW | A2 | CHR$ | C7 |
| TAB( | A3 | LEFT$ | C8 |
| TO | A4 | RIGHT$ | C9 |
| | | MID$ | CA |

TABLE 3

TOKENS (shorthand used in BASIC text)

**ENTERING THE PROGRAM**

The hard way to load the program into your PET is to convert my hex listing into decimal and POKE each byte into memory. This is, of course, a challenge to your accuracy and diligence, although it may take only slightly longer than renumbering by hand. It is only a little easier to write a BASIC program which will accept the hex data and convert to decimal, with the hex incorporated in DATA statements and obtained by the READ statement. With this alternate, the program can be recorded for future use.

To make loading painless (excpet for the wallet), I have arranged to make tapes available through NAIL*, Drawer F, Mobile, Alabama 36601. These tapes load the machine-language program directly into high memory. Ask for "SYS8181" and send $18.18. By the way, they also have a dandy PET monitor called SYS7171 for $29.71, which has machine language capabilities, the ability to co-reside in RAM with BASIC programs, but also has the very helpful feature of being able to APPEND one BASIC program to another, just like the big boys do, with interleaving of lines. Like SYS8181, it uses the BASIC line-inserting routine to do the merging, just as though you typed all those new lines on your keyboard. I used a version of this monitor to develop SYS8181. If there is sufficient interest out there, I may develop a ROM version of SYS8181, but you will have to be a hardware buff to wire it into your PET.

Since PET BASIC was written by the same company who write APPLESOFT and is similar, some APPLE owners may wish to obtain a disassembled, documented listing of this renumbering program from me for $5.00.

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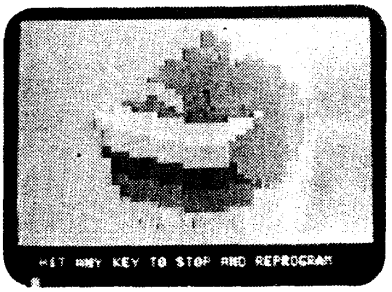


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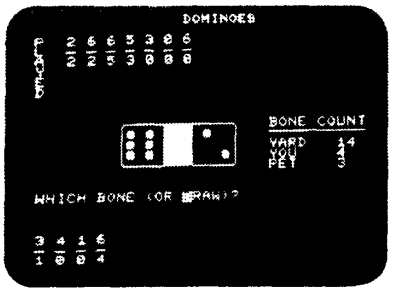


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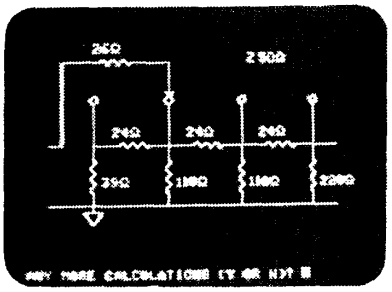


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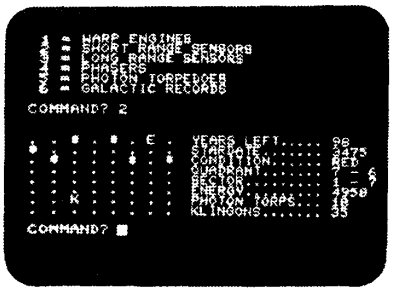


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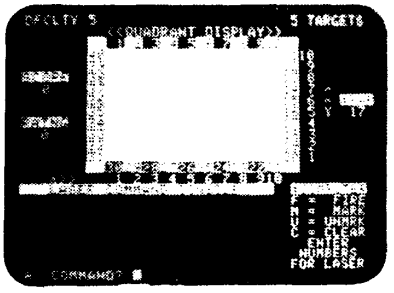


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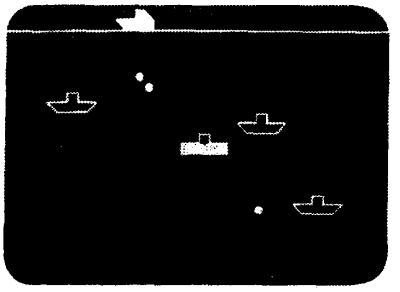

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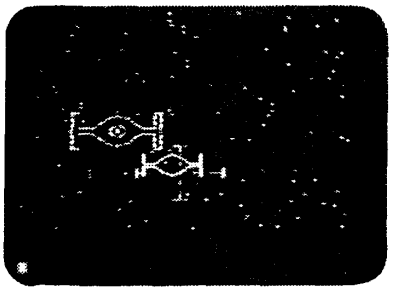

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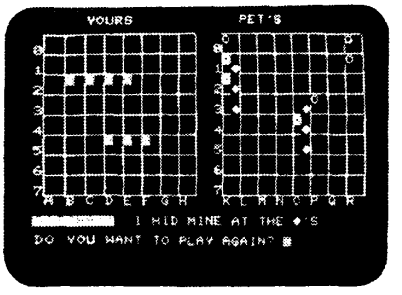


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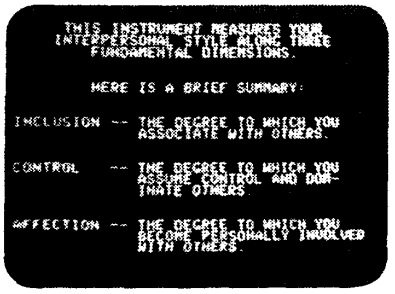
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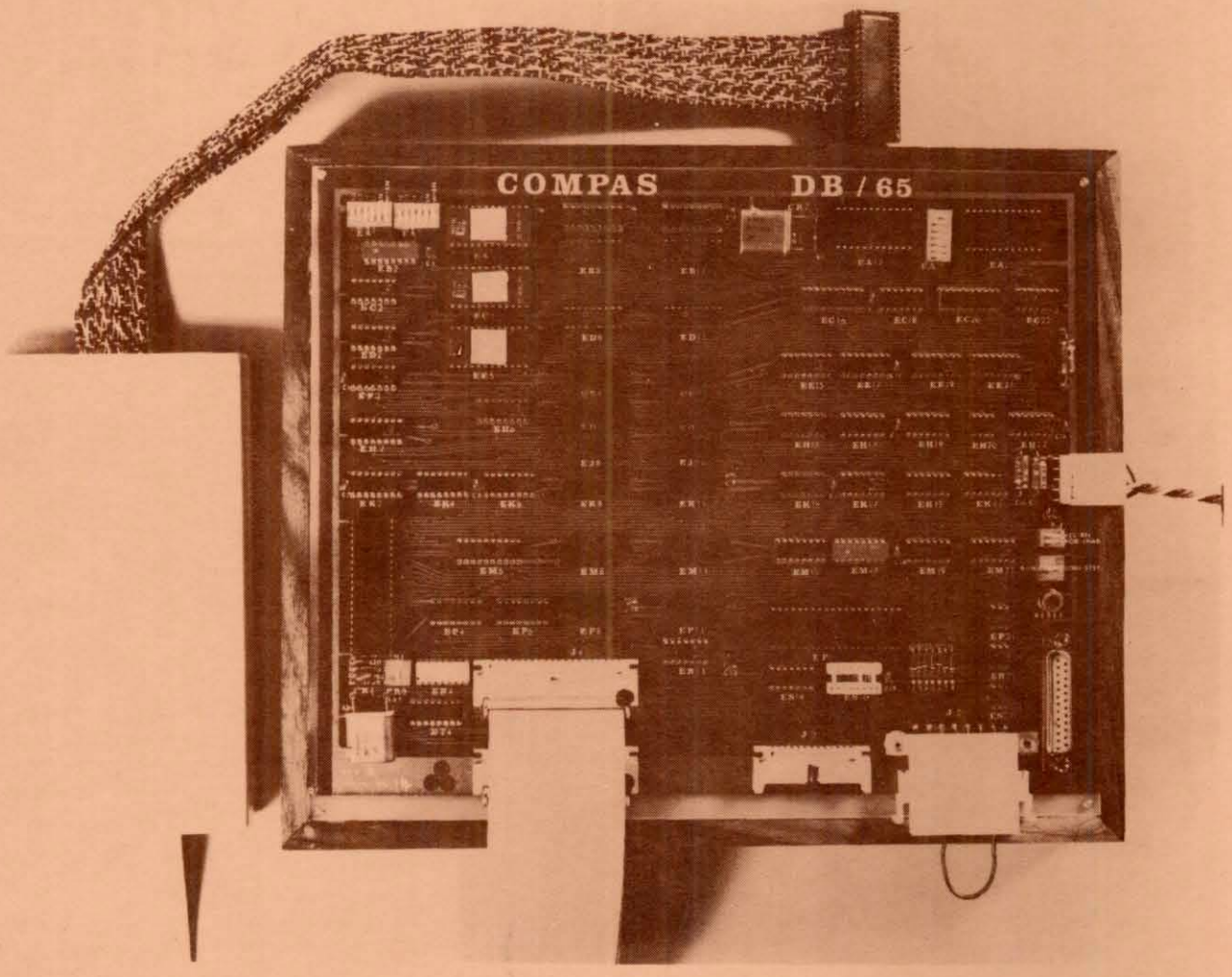


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